THE AEROPLANE

Incorporating
Aeronautical Engineering

Edited by - - THURSTAN JAMES

Founder and First Editor
(1911-1939), C. G. GREY

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RESPONSIBILITY FOR RESEARCH

MOST important of the various events which have taken place since last week's leader went to press has been the statement by Mr. Aubrey Jones in the House of Commons on May 13 regarding the future policy of the Government as regards research and development in the aeronautical industry. This elicited a reply from Mr. Cyril Uwins, President of the S.B.A.C., who pointed out that the Minister's statement had been couched in such general terms that to comment on it in great detail at the present stage would be difficult. "We shall look forward," concluded Mr. Uwins, "in the near future to seeing on what lines the development of this policy will proceed."

During the same period the 46th Wilbur Wright lecture had been given by Dr. G. W. H. Gardner, superintendent of the Royal Aircraft Establishment. The lecturer admitted he had been tempted to discourse on the future potentialities of aircraft, manned and unmanned, and, in particular, on ways in which a vigorous research activity could create new and valuable realizations hitherto unsuspected. Although he resisted this temptation in selecting the subject of his lecture, he hoped that the interest of his story would not be confined to the historical aspect. In his view the story provided one example from which some deductions flow relating to the place of research in Government establishments in relation to the overall aeronautical activity in this country.

In passing, it seems worth emphasizing Dr. Gardner's point that the German V.1, first launched against Britain on June 13, 1944, was based on the same control and navigation concept as the R.A.E. Larynx unmanned bomber tested in Iraq in 1929.

When the decision was taken not to produce the unmanned bomber circumstances were such that it was, we think, the right thing to have done. When the Germans built theirs, the obstacle that held them back was the combination of the Navy at sea and the R.A.F. in the air. The German unmanned bomber only needed enough range to reach across the Channel to London, a British unmanned bomber would have to cross the Channel, and France to the Ruhr and farther.

At the conclusion of his paper Dr. Gardner noted that many of the most important and fruitful contributions of the Government establishments are in the form of new ideas and techniques. The extent of these contributions has influenced greatly the tempo of our national aeronautical advance.

One can readily appreciate that at one time it was possible to reason that as aeronautical research was vital for military purposes and as it cost so much money, any return from civil adaptation and application was by way of a bonus which could be used to offset the drain on the country's pocket-book. But today the aircraft industry has built up an impressive standing as an exporter, not least in hard currency markets. This activity will continue, but if it is to expand it must be backed by an effort in the fields of research and development comparable with what has taken place in the past. And if the Government has decided to cut down the military side of aeronautical production to the extent that Mr. Jones envisaged (he quoted figures showing a reduction of 100,000 men), then somehow ways must be found to ensure that aeronautical research work does not suffer.

No doubt spacecraft work will go on, for even if as appears, there is no British official interest in spacecraft as such, we are committed to a great deal of work in the field of guided missiles.

However, the problems that vex most thinking people in the aircraft industry have to do with such promising new developments as the Fairey Rotodyne, which even today is without any rival (unless in Russia) in the combined field of high cruising speed and vertical flight capacity. So many people have read of Dr. Wallis' variable-sweep monoplane that there is a tendency to regard this as the only solution to the problem of the supersonic transport. It is, of course, just one of a number. Equally people tend to think that the multi-unit small-size vertical-thrust-producing turbine battery is the only solution to vertical take-off for transports. It is not; and in this country there has been much original thought and study put into some extremely ingenious solutions to the problem of how to accelerate sufficiently large masses of air vertically downwards to lift large aircraft off the ground in a level attitude and under complete control. Then there is the vital problem of boundary layer control, which was shown 20 years ago in this particular aeronautical newspaper to promise remarkable flying economies. Now research work and investigation have gathered much more information.

As things are today, concern at the Government's attitude will not be allayed until a clear policy has been laid down to ensure the co-ordination of national research with the estimated trends of development in the international field of air transport. Nobody doubts we have the brains and men to build the aircraft and spacecraft of tomorrow; it would indeed be lamentable if these abilities languished through lack of national understanding.

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MATTERS OF MOMENT

Noise and Russia's Jetliner

LAST WEEK a Tu-104 of Aeroflot brought members of the Moscow Arts Theatre to this country, but instead of being allowed to land these distinguished visitors at our premier airport, the aircraft was sent instead to Stansted in Essex whence they finished their journey to London by road. This inconvenient diversion had to be made because the Ministry of Transport and Civil aviation considers that the Tu-104 makes an "excessive" noise and would therefore have caused too much of a disturbance among the local inhabitants around London Airport's perimeter. But for all that, in the event, according to reports, the aircraft's arrival at Stansted does not seem to have been particularly conspicuous for its loudness.

With the noise level of Russia's standard jet airliner thus in the news, we are fortunate in being able to include in this issue of THE AEROPLANE a translation of a Russian article on the subject (pages 721-722). This discusses in detail some experiments that were carried out by a Russian scientific research institute and compares the results obtained for the Tu-104 and the Il-14 with published figures for various Western transport aircraft.

Readers will find, incidentally, that in the article reference is made to decibels and to phons as units of noise measurement—which may tend to be a little confusing to those not closely concerned with the science of acoustics. The decibel is a comparative unit of noise intensity (it is in fact a logarithmic function of intensity ratio). The same proportional change of noise intensity—no matter what the absolute values—will give the same difference expressed in decibels; for example, a twofold change in noise intensity will be represented as 3 db. whatever the noise levels concerned.

The phon, on the other hand, is a standard unit of loudness. In this respect, it is analogous to the foot-candle used in the measurement of light.

Paying for Research

VERY much in the aeronautical limelight last week was the long—and eagerly—awaited statement by Mr. Aubrey Jones, the Minister of Supply, concerning the Government's future policy in relation to costs of research and development.

Broadly speaking, the Government has recognized the imperative need to preserve a proper continuity in fundamental research and, therefore, proposes to continue for the time being to be financially helpful—at about the same scale as at present. It is, however, suggested that at some time in the future it will be possible to differentiate between research directed towards defence projects and that with a special application to civil aviation. When that happens, the industry itself will be expected to bear the cost of such civil research unaided.

So far as the payment for development—as apart from research—is concerned, the Minister made it clear that for new civil projects the companies involved would have to be responsible. However, an exception to this might, it seems, be made in the case of the more radical designs such as those for VTOL aircraft and the supersonic airliner.

In his statement the Minister said: "The current reduction in defence demands, both in numbers and for certain types of manned combat aircraft, will inevitably entail some contraction in the present size of the British industry, but there will still be a need for an efficient and economic industry to meet the Service's requirements for aircraft and guided weapons. The Government will therefore continue, as necessary, to sponsor and finance aeronautical research and development to meet these defence requirements."

Mr. Jones drew attention to the "valuable contribution" that has been made by the aircraft industry to the country's economic and technological progress. "So long as the achievements of the industry justify the expenditure of the public money involved," he said, "the Government intends to continue to make a financial contribution to aeronautical research in the expanding field of civil transport, where this is not already covered by the research necessary for defence purposes; such finance will be on a scale adequate to enable the industry to maintain its leading position. The Government have taken this decision in the expectation that in course of time the industry itself will progressively assume financial liability for civil research. . . . The future of research depends, then, on the progress made by the industry itself."

The Minister concluded by saying that provided the industry carried out the necessary reorganization it should "in general be able increasingly to finance the development of new civil projects without Government assistance." He added that it recognized that the development of a "future generation" of aircraft might require a measure of Government help. They would, therefore, "be prepared to consider individual applications for development assistance on their merits."

Mr. Jones enlarged a little on his statement in answers to questions both in the House and at a Press conference afterwards. He could not, however, be tempted to give any time scale to the changeover to the industry's civil research responsibility; nor would he give any indication of the actual value of present Government outlay, which is to be continued for the time being. On the subject of the future contraction

LONDON OCCASION.—Queen Elizabeth The Queen Mother, Chancellor of the University of London, inspects the U.L.A.S. Guard of Honour when she arrived at the Royal Albert Hall for the Presentation of Degrees on May 14. With her is the C.O. of the Squadron, Wg. Cdr. N. Cameron, D.S.O., D.F.C.

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of the aircraft industry, he suggested that during the next five years or so the volume of work available would support only three or four major airframe companies and two aero-engine companies. This, he thought, would mean a cutting back of the present manpower figure of around 250,000 to the "pre-Korea" level of 150,000.

Sputnik or Spaceship?

LONG-AWAITED, the launching of Sputnik III took place on May 15 last, with every promise of being as successful as its predecessors. For some months the rest of the world had been led to believe the Soviet scientists would attempt to hit the Moon, but more recently Soviet news agencies have been strenuously playing down the idea. It is reasonable to assume, therefore, that they have launched their satellite with some other aim in view, and require time to prepare something more sophisticated in order to accomplish the lunar mission with any hope of success.

Nevertheless, once again the Russians have astonished the World by demonstrating the lifting power of their ballistic missiles. Sputnik III is far and away the heaviest object to be put in orbit so far. Its weight is given as 2,919 lb. and it is moving in a mean orbit 660 miles above the Earth. The period is 106 minutes, closely comparable to that of Sputnik II and, judging by the similarity of orbit and the exceptional weight, its life should be not much less than a year.

The satellite is described as a cone-shaped object that has detached itself from the final rocket stage, which is also in orbit. The cone has a base diameter of 70 in. and a length of 11 ft. 8 in. Radio and scientific equipment totalling 2,133 lb. is being carried.

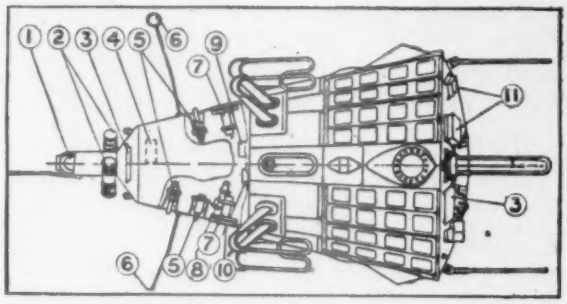
From the character of the signal being picked up on 20.005 megacycles, the telemetry is broadcasting only four separate channels, which seems rather inadequate to deal with the variety of instruments stated to be in the satellite. Power is said to be provided by solar batteries that convert the Sun's radiant energy directly into electrical power, and measurements are being made of atmospheric pressure, solar and cosmic radiation intensity, internal and external temperature, as well as other geophysical phenomena. Unfortunately, the latest reports indicate that the signals are becoming weaker.

It is tempting to ask whether Sputnik III might not in fact be the prototype of a small, one-man spaceship? Its size and weight are not in keeping with the few instruments it carries, and it is roomy enough for a fair-sized cabin. If this satellite has no animals aboard it might be that Sputnik III is a reconnaissance satellite fitted with television cameras.

The World might also speculate whether the weighty payload does not perchance include a battery of braking rockets and parachutes. Maybe it is intended to recover the satellite at an opportune moment though, if this is the plan, the time is not yet ripe.

At present the satellite is ranging between a perigee of roughly 150 miles (some 60 miles above the critical break-up height) out to an apogee 1,175 miles distant. The ellipticity of this orbit will alter with every revolution, contracting mainly at apogee until eventually the orbit becomes near-circular.

This will be the moment to fire the recoil rockets in opposition to the flight path, thereby reducing speed to a value that would make it safe to re-enter the atmosphere without excessive kinetic heating. Accurately carried out, such an attempt has a reasonable chance of coming off. Should it be successful, the Soviet Union would be in a position to follow it up by launching the first man-carrying satellite into space. Certainly they seem to have the technical knowledge and the capacity to do it.—I. G. WHY.



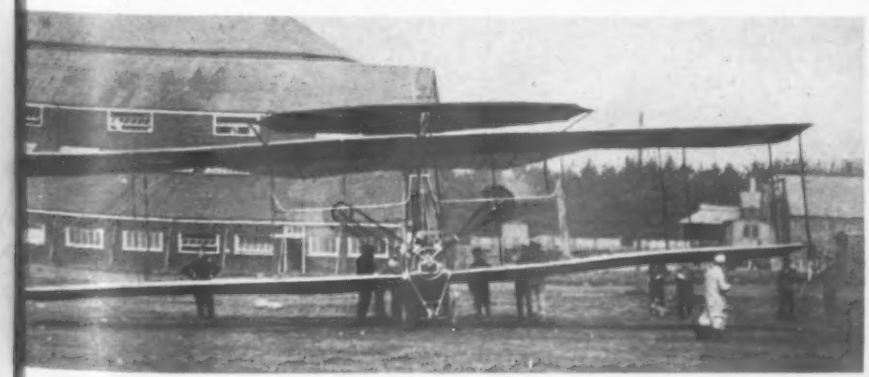
SPUTNIK III.—Key: 1—magnetometer, 2—instruments for measuring solar radiation, 3—solar batteries, 4—cosmic ray meters, 5—ionization manometers, 6—ion traps, 7—electrostatitical fluxmeters, 8—mass spectrometric cube, 9—instruments for recording heavy nuclei in cosmic rays, 10—for measuring intensity of primary cosmic radiation, 11—for measuring micrometeors.

Burtonwood Reductions

ONCE again the U.S.A.F. Base, Burtonwood, marked U.S. Armed Forces Day—this year on May 17—by throwing open its many gates to the British public. More than 80,000 people took advantage of American hospitality, for the occasion was probably the last time the public at large will see Base activities in their present form.

On June 30 the Northern Air Materiel Area, Europe, whose headquarters and present commander, Brigadier-General Frederic H. Miller, are at Burtonwood, ceases to exist. By that time, General Miller, whose acquaintance with Britain dates back to 1943, when he was at Empire Central Flying School, Hullavington, will be Director of Materiel Programmes, "up to my knees in paper at the Pentagon."

After June 30 the senior organization at Burtonwood will be the European Northern Disposition Task Force, which has



FIFTY YEARS BACK.—In the first volume of "The War in the Air" by Walter Raleigh which forms part of the Official History of the Great War, Mr. S. F. Cody, (right) described as a hardy individualist of the old school, is stated to have built in 1908 an aeroplane, similar in type to the machine of Mr. Glenn H. Curtiss, in which he made many experimental flights over Laffan's Plain. Next week we hope to publish letters from Mr. Charles Gibbs-Smith and Mr. G. Verdon-Roe in reply to "Cody De-Cody-fied" which appeared last week from Captain Laurence Pritchard.

been at Burtonwood since January 1 this year. The Task Force's commander, Colonel Edwin J. Hamilton, will also become commander of the base. The number of people at Burtonwood—Service and civilian—is to be cut by 1,000 to 3,500 this year.

Security or Over-confidence?

ACCORDING to the dictionary "security" can be taken to mean over-confidence. Certainly, our security system gives no cause for this as shown by recent disclosures on the latest British missiles in an American magazine. Our American friends are hardly to blame; they print such news as they discover.

Thus readers are informed that the de Havilland Propellers IRBM is code-named Blue Streak; the de Havilland Aircraft Co. are "presumably" responsible for airframe construction and final assembly; Rolls-Royce are responsible for powerplant development and production (Rocketdyne liquid propellent engine built under licence from North American Aviation); the Sperry Gyroscope Co. are responsible for development of the missile guidance system and associated electronics; Saunders-Roe are responsible for development and construction of the Black Knight re-entry test vehicle.

The report refers to "cold flow" systems test towers at de Havilland Propellers and states that two stands have been built and instrumented for "captive" tests of Black Knight by Saunders-Roe on the Isle of Wight. The Saro towers are said to resemble those of de Havillands and mention is made of a Rolls-Royce rocket-engine test stand at Spadeadam Waste, Cumberland, for static firing of the engines and for propulsion-system development.

The use of an American thermonuclear warhead and re-entry body, such as that of the Thor missile, is propounded, the point being that General Electric make this and also happen to have technical exchange and manufacturing agreements with de Havillands for gas turbines (the G.E. T58/D.H. Gnome) which could be extended to cover missile work.

With this most recent disclosure code-names now published include Red Dean (Vickers air-to-air), Blue Jay (D.H. Firestreak), Blue Sky (Fairey Fireflash), Red Duster (Bristol Bloodhound), Red Shoes (English Electric Thunderbird), Red Hawk, Blue Boar, Sea Slug, Blue Streak and Black Knight.

Oxford U.A.S. Dinner

HIGH-RANKING R.A.F. officers and senior members of the University were out in force at the annual dinner of the Oxford University Air Squadron on May 9. Among the guests were the Chief of the Air Staff, Marshal of the R.A.F. Sir Dermot Boyle, and all the officers who had commanded the squadron since 1945.

The guests were welcomed by WG. CDR. A. J. DOUCH, M.A., who had taken command of the squadron 14 days before. He expressed the hope that advanced squadron members might in future be able to receive flying experience on Vampires. In pre-War days squadron members had been able to fly Service types such as the Hart and Hind.

Replying for the guests, SIR DERMOT BOYLE spoke of the R.A.F.'s continuing need for pilots. With aircraft costing up to £1 million each, pilots of the highest quality were needed. He went on to regret that the establishment of the squadron had perforce been cut from 100 to 60.

The toast to the squadron was proposed by MR. J. C. MASTERMAN, O.B.E., M.A., Provost of Worcester and Vice-Chancellor, who paid tribute to the work of Wg. Cdr. M. H. Constable Maxwell, the squadron's commander until recently. He spoke of the appreciation the University felt for the O.U.A.S. because of its diversity, interest and fine spirit.

MR. R. L. M. DAWSON of Magdalen replied for the squadron. If it could not have the fast and beautiful fighters it would like, he said, it would wish for the re-formation of a group of fast and beautiful lady fighter-controllers.

During the dinner the Hack Trophy for the best all-round member was presented to Mr. I. W. Rixon of University College, and Mr. J. T. R. Coburn of Worcester College received the Flying Proficiency Trophy.—J.R.C.

An Automatic Canberra

FOLLOWING the disclosure of the existence of a radio-controlled target version of the Canberra, by Dr. G. W. H. Gardner, Director of the R.A.E., at his Wilbur Wright lecture last week, a little more information was made available regarding this important project by the companies concerned. Developed by Short Brothers and Harland, the Canberra U Mk. 10, as it is called, is intended for unmanned operation as a target aircraft for use during guided weapons firing trials. It is basically a Canberra B Mk. 2 and, according to the official statement, is capable of fully automatic operation "in all phases of flight." It has been reported that more than 100 flights have been made by the new unmanned Canberra—although during these development flights a pilot has, in fact, been carried; even though on many occasions he has not touched the controls from take-off to touch-down.

One of the principal advantages of the Canberra as a target is its more "representative" size and the large reflecting surface on to which the missile can home. Its speed and high-altitude performance—to say nothing of its considerable endurance at height—are also of major importance for such a rôle. No details of the capabilities of the Canberra U Mk. 10 and the associated ground equipment have been given, but it has been said that full remote control can be achieved up to the limit of the aircraft's altitude performance.

Mr. Gardner in his lecture said that the new aircraft is not yet in operational use. Presumably when these machines are put into operational use for the testing of guided weapons they will be employed at Woomera. There at present Jindiviks and Meteors are used.

Bridge to Heliport

SINCE our note on "Heliports on the Thames" (THE AEROPLANE, May 16) we have learnt from Rotorports, Ltd., that it was plainly stated by Mr. Michael Beckman, who appears for that company, that application is, in fact, being made for a flexible gangway between the floating platform and the Albert embankment. On this basis the application is being considered by the Ministry of Housing and Local Government. Rotorports now inform us that it has always been the company's intention to negotiate for a fixed flexible gangway, but the detailed design was being left until after formal Government permission had been obtained.

NO HANDS.—A Canberra U Mk. 10 making an automatic take-off under remote radio control at a M.o.S. airfield. The pilot monitoring the working of the system is Sqn. Ldr. D. R. Turley-George, D.F.C., a Shorts test pilot, responsible for the flight development programme.

News of Aircraft, Engines and Missiles

STUDENT TOUR.—Flight development of the Miles Student, in the hands of Flt. Lt. Duncan McIntosh, Miles chief test pilot, has reached the point where a Special Category C. of A. is to be applied for and a demonstration tour planned on the Continent. The Student will visit Denmark, Finland, Germany, Holland and Sweden, and will offer particularly favourable economy for these countries in costing about one-third the price of its Continental competitors.

EVEN FASTER.—A new World's air speed record is being claimed by the U.S.A. On May 17 Capt. W. W. Irwin, U.S.A.F., flew a Lockheed F-104A Starfighter at about 40,000 ft. near Edwards A.F.B. and achieved 1,404.19 m.p.h. over a measured course. The previous record, as yet unconfirmed, was 1,207.6 m.p.h. set up in December last in a Voodoo. Officially the record is still held by Peter Twiss in the Fairey F.D.2 with 1,132 m.p.h.

NOSE CONE RE-ENTRY.—The nose cone from a Jupiter IRBM was recovered from the Atlantic on May 18, 4¾ hr. after the missile had been fired from Cape Canaveral. It had re-entered the atmosphere successfully some 1,500 miles from the launching point.

GERMAN LIGHTWEIGHTS.—Two new prototypes are being built at the Aeronautical Institute in Dresden by students of the technical high school under Prof. Landmann. The Kaplick-Kerl is a two-seat jet trainer, all-metal, generally resembling the Air-Fouga Magister. It weighs 6,613 lb. and should achieve about 466 m.p.h. Span, 35 ft. 1½ in.; length, 32 ft. 9½ in. Designed primarily for glider towing, the second type, the Boenisch-Vogel, is a single-seat low-wing monoplane with fixed undercarriage and powered by a 125-145 h.p. air-cooled engine. Estimated performance: towing speed, 62-70 m.p.h.; landing speed, 41.9 m.p.h. Span, 41 ft. 1 in.

JAPANESE S-55s.—Mitsubishi Heavy Industries of Tokyo has been licensed to build the American Sikorsky S-55 helicopter in Japan.

TRIDENT TERMINATED. — In announcing that all further development of the Trident II is to be stopped, M. Georges Hereil, chief of Sud-Aviation, said that the aircraft's possibilities "are far from exhausted but . . . it will no longer be possible to demonstrate them . . . because of restriction in the national aeronautical budget."

IN GERMANY. — The single seat Turbulent D, based on the French design, is being produced at Minden, West Germany, by Starck Flugzeugbau. It has a 42-h.p. Stamo 1,400 engine and achieves 109 m.p.h.

VOLTIGEUR REVEALED. — The first flight of the Sud-Aviation S.E.116 Voltigeur two-seat support aircraft, formerly known as the Fonceur, is scheduled to be at the end of this month or early next. The Voltigeur—approximate dimensions are: span, 59 ft., and length, 41 ft. — has two 650-s.h.p. Turboméca Bastan turboprops and is to cruise at about 290 m.p.h.

A NEW PIAGGIO

ILLUSTRATED on page 729 of this issue is the Piaggio P.166 executive aircraft, which uses the mainplanes, engine nacelles and mainwheels of the P.136 amphibian. The P.166, powered by two 320-b.h.p. Lycoming GSO-480-B1C6 engines driving Piaggio P.1033 propellers first flew on November 26, 1957, but has only just been released. Span is 46 ft. 9.4 in.; length, 38 ft. 7 in.; gross wing area, 285.89 sq. ft.; empty weight, 5,020 lb.; disposable load, 2,580 lb.; gross weight, 7,600 lb.; max. speed, at 10,000 ft., 225 m.p.h.; cruising speed, 197 m.p.h.; initial climb, 1,410 ft./min.; service ceiling, 25,600 ft.; range, 1,300 miles; stalling speed, 69 m.p.h.

TEMCO NAVAL TRAINER.—A more powerful version of the Temco TT-1 jet trainer of the U.S. Navy, designated the TTX, is to be produced to teach carrier-landing techniques.

LUALDI PRODUCTION.—Following an agreement between Aer Lualdi, of Rome, and Aeromere S.p.A., of Trento, Lualdi helicopters are to be built in the former Caproni works at Gardolo, Trento. Initially pre-production aircraft will be built. The Lualdi L-55 four-seater was illustrated in our issue of April 18.

NAVAL ETENDARD.—The prototype Marcel Dassault Etendard IV M, intended for the French Naval Air Service, is being assembled and should be completed by the end of this month. It has a SNECMA Atar 8 turbojet and incorporates several modifications over the Atar E-powered Etendard IV. The new version is fully navalized and has an Area-ruled fuselage.

EPERVIER FLIES.—First flight of the Morane-Saulnier MS.1500 Epervier tactical support aeroplane was on May 12 at Bretigny. M. Jean Person was the pilot.

PRESIDENTIAL 707s.—According to reports from Washington, three Boeing 707s are being purchased for use by President Eisenhower and high Government officials when making long-haul flights. They are to be delivered late this year or early in 1959.

ION PROPULSION.—U.S. contracts for ion-propulsion have been given to Vitro Laboratories and the General Dynamics Corpn. Vitro Laboratories will investigate the high-intensity arc for ion propulsion and General Dynamics will make analytical studies of this form of propulsion.

SUPER BOMARC.—An advanced version of the Bomarc surface-to-air missile will soon be tested by the Boeing Airplane Co. Its range is 400 miles, twice that of the original Bomarc.

STARS BY DAY.—Northrop Aircraft, Inc., has perfected an automatic star-tracking device which will work in broad daylight. Important applications are expected for missiles and interplanetary vehicles.

ADDED ILYUSHIN.—At the end of his recent Moscow visit, President Nasser of Egypt was presented with a luxuriously equipped Ilyushin Il-14 for his personal use. The Egyptian Air Force already uses a number of Il-14s for V.I.P. and general transport duties.

NAME CHANGED.—Hoppi-Copters, Inc., has changed its name to the Helicopter Corpn. of America. The company is to continue building single- and two-seat helicopters.

NEW PIPER. — The Comanche 250, powered by a 250-h.p. direct-drive Lycoming O-540-A1A engine, is now in production at the Piper Aircraft Corpn.'s plant at Lock Haven, Penna. It cruises at more than 180 m.p.h. and the fully loaded rate of climb is 1,400 ft./min. The earlier Comanche had a 180-h.p. Lycoming.

Commercial Aviation Affairs

B.O.A.C. CARGO.—The senior airline Corporation has appointed Mr. W. D. Koster as cargo manager. This development is part of a long-term plan to exploit the air-freight market and to obtain enough traffic to match the capacity of the new equipment. Mr. Koster has been concerned with air forwarding since 1930. He joined Imperial Airways in 1934 and, after service in the R.A.F., he was cargo superintendent of B.S.A.A. Before his present appointment he was B.O.A.C.'s cargo sales manager.

LESS PROFIT.—According to the Air Transport Association, the U.S. airlines recorded, in 1957, a record revenue of about £714 million, but profits were down to about £15 million. As a profit margin, this was the lowest since 1950 and a margin of only 2.6% is forecast for 1958. Passenger-miles for 1957 totalled 31,243 million—the highest figure in U.S. airline history.

FAST CROSSING.—On May 15-16 a B.O.A.C. Comet 2E on one of the trans-Atlantic training flights made the crossing from Gander to London Airport in 4 hr. 21 min.—a block average of about 540 m.p.h. for the 2,345-mile sector. The Comet had left L.A.P. at lunch-time on May 15.

U.S. INVESTMENT.—Seaboard and Western Airlines, from whom the new Atlantic operating company Aerlinte Eireann have leased L-1049s, have invested £500,000 (26% of the total capital) in the Irish company and are represented on the board.

P.A.A. RESULTS.—For the first time in 30 years no subsidy element is included in P.A.A.'s financial results for 1957, yet a net income, after taxes, of £2,928,572 was returned. The revenue passenger-mile and passenger number figures (at 3,876,000,000 and 2,833,000) represent increases of 14.5% and 11.2% respectively.

TO BRUSSELS.—On May 13 Silver City Airways opened their new service between Newcastle, Leeds and Brussels, which is being operated on Tuesdays and Fridays with 36-seat DC-3s.

CARGO POOL.—B.E.A. and Lufthansa have agreed on an integrated pooling programme for their all-freight services between London, Düsseldorf, Frankfurt and Stuttgart. There are now 11 all-cargo services a week in each direction between London and Germany. B.E.A. uses DC-3s and Lufthansa uses Vikings.

B.O.A.C. TO SOUTH AMERICA.—The Ministry of Transport has stated in the House that B.O.A.C. expects to re-open the South American services in the spring of 1960 using Comet 4s. This, it was said, is the earliest date at which Comets would become available for these operations.

C.P.A.L. INAUGURAL.—The Britannia 314 services between Vancouver and Amsterdam are due to start next week-end, June 1. An inaugural flight, with journalists and travel agents, was made last week-end. Very strong westerly winds disrupted the schedule and the Britannia had to divert to Goose Bay.

ETHIOPIAN DC-6Bs.—Early this month, the first of three Douglas DC-6Bs was delivered to Ethiopian Airlines, which is managed and operated by T.W.A. for the Ethiopian Government. The 6Bs will be used for services to Europe and East Africa, and a special stateroom and executive suite have been provided for use in any one of the three aircraft.

SCHOENEFELD EXTENSION.—A new concrete runway about 11,000 ft. in length is to be laid at Schoenefeld Airport, outside the eastern zone of Berlin. It is a bid to divert international traffic from Tempelhof, which cannot be extended.

SUBSIDY REQUESTS.—On May 8 the Flying Tiger Line filed with the C.A.B. an application for subsidy assistance. Similar applications had already been made by Riddle Airlines, Slick Airways and Aaxico Airlines.

K.L.M. IN 1957.—During last year K.L.M.'s passenger ton-miles increased by 14% and the number of passengers rose to 913,000 as compared with 822,000 in 1956. Income from all sources showed an increase of 15%, but rising costs resulted in a profit which remained approximately at last year's level.

INSTRUCTORS' CERTIFICATES.—The Guild of Air Pilots will, from July 1 and in agreement with the Ministry of Transport, increase the fees for Instructors' Certificates. These will now be: initial application, £4 4s.; re-test, £3 3s.; renewal, full instructor, 15s.; and renewal, assistant instructor, £1 1s.

FULL-SCALE RESEARCH.—The U.S. Airways Modernization Board has, according to *Aviation Daily*, asked for $35 million to finance its 1959 activities and will require 14 aircraft for "live" experimentation over the air routes and at the terminals. Three (small) aircraft are to be bought and the remainder, including a twin-jet bomber and a four-engined transport, are to be leased from the Services.

B.O.A.C. BAN ENDED.—On May 13 the B.O.A.C. engineers and electricians decided to lift the overtime ban which was imposed last month.

THE BELFAST INQUIRY.—It was stated in the House of Commons last week that the public inquiry into the accident to the B.E.A. Viscount at Nutts Corner Airport, Belfast, would start on July 8.

ACCIDENT AT DELHI.—A Pakistan International Airways' Convair 240 crashed immediately after take-off from Palam Airport, New Delhi, on May 15. Of 32 passengers and six crew there were 17 survivors.

SABENA LOSS.—On May 18 a Sabena DC-7C crashed into a hangar at Casablanca, Morocco, while making an emergency landing. It was flying on the Brussels-Leopoldville service. Of the 69 persons on board, including a flight and cabin crew of nine, only four passengers survived.

B.E.A. ACCIDENT.—The flight crew of three (the sole occupants) were killed on May 16 when a B.E.A. DC-3 freighter crashed at Nemours, south-east of Paris. It was flying on the London-Nice-Rome cargo service.

WINTER HILL INQUIRY.—The public inquiry into the accident on February 27 to the Silver City Airways' Bristol 170, G-AICS, on Winter Hill, near Bolton, will start at 10.30 hrs. on June 12 at Holborn Town Hall. The commissioner will be Mr. J. Megaw, Q.C., and the assessors will be Capt. T. Nisbet, D.F.C., and Capt. I. D. Wallace, D.F.M.

A.R.B. LEAFLETS.—A further issue of Civil Aircraft Inspection Procedure leaflets has been made by the Air Registration Board. They include the first issue of sections dealing with the responsibilities of inspectors and the position of inspection organizations in the scheme of things.

Military Aviation Affairs

TARGET TUG.—The Meteor TT.20 high-speed target tug developed by Armstrong Whitworth Aircraft, Ltd., from the Meteor NF.11 to R.N. requirements. An M.L. Aviation type G fully feathering windmill winch is mounted above the starboard inner wing and there is provision for four high-speed radar-responsive targets.

BOMBING CONTEST.—Vulcans, Valiants and four B-52s of the U.S.A.F. took part in the R.A.F. navigation and strategic bombing contest for the Laurence Minot trophy, May 14-20. Targets included London, Glasgow, Birmingham and Manchester; bombing accuracy was assessed by ground radar.

CANADIAN AID.—The R.C.A.F. is supplying eight T-33 Silver Stars to Greece and 17 to Turkey as additional Canadian contributions under Mutual Aid arrangements. The aircraft, all Mk. 3s, are being flown across the North Atlantic in one operation by R.C.A.F. Training Command.

NAVAL AIR SQUADRON.—No. 831 Sqn. was re-commissioned on May 1 after being disbanded in 1957. Re-formed from the former No. 751 Sqn., and commanded by Lieut. Cdr. W. J. Hanks, R.N., it is equipped with Sea Venoms and Avengers.

INDONESIAN DEVELOPMENTS.—According to Air Vice-Marshal Surydharma, C.-in.-C. of the Indonesian Air Force, his units are being supplied with a variety of aircraft ranging from gliders to jet and conventional trainers and jet fighters and bombers, from Yugoslavia, Czechoslovakia and Poland. The Indonesian Air Force last week attacked the North Celebes rebel capital of Manado, destroying three Mustangs and one Catalina on the airfield, and two more rebel aircraft at Tauka airfield, to the north of the capital. One rebel bomber, a Douglas B-26, was also shot down by ground fire while attacking Ambon airfield in Jakarta.

GOSPORT MEMORIAL.—Air Chief Marshal Sir Arthur Longmore is to unveil a memorial at H.M.S. "Sultan," formerly R.A.F. Gosport, on May 28, to commemorate the close ties of the airfield with the development of Service aviation. One of the first five airfields chosen for the R.F.C. in 1912, Gosport was operated by the R.A.F. until it was transferred to the Royal Navy in 1945. Service representatives to be at the ceremony include Admiral Sir Denis Boyd, a former Fifth Sea Lord, and Air Marshal Sir Bryan Reynolds, A.O.C.-in-C., Coastal Command.

NATO FIGHTERS.—Following the selection of the Fiat G.91 as the "first-phase" lightweight strike fighter for NATO, an order for 50 has been announced for the Luftwaffe. The G.91 will also be used by the Italian Air Force, and will probably be supplied to other NATO countries, such as Turkey and Greece. The "second-phase" North Atlantic tactical fighter is the Breguet 1003 Taon, powered by an 8,000-lb. Bristol Orpheus B.Or.12. The prototype Taons are currently being evaluated for possible carrier operation.

BOMARC BASES.—The U.S.A.F. is to build 10 new Bomarc anti-aircraft missile bases at existing airfields at a cost of $121 million. Four Bomarc bases are being built in the north-east U.S.

News About People

H.P. DIRECTORS.—Mr. R. S. Stafford, C.B.E., F.R.Ae.S. (left), director of the Handley Page technical department, and Gp. Capt. R. C. M. Collard, D.S.O., D.F.C., the company's sales manager, have been appointed directors of Handley Page, Ltd., and of Handley Page (Reading), Ltd. Sir Arthur Vere Harvey, C.B.E., M.P., has resigned from the two boards on becoming chairman of the CIBA companies in Great Britain. Sir Thomas S. Overy has also resigned from the two Handley Page concerns. Mr. E. Manley Walker is also appointed a director of Handley Page, Ltd.

F.A.I. PRESIDENT.—Miss Jacqueline Cochran (Mrs. Floyd Odlum) has been elected President of the Fédération Aéronautique Internationale.

R.Ae.S. REPRESENTATIVE.—Mr. E. D. Keen, chief designer of Sir W. G. Armstrong Whitworth Aircraft, Ltd., has been invited by the Council of the R.Ae.S. to represent that body on the new Advisory Committee of Aeronautical Engineering at the Loughborough College of Technology.

R.C.N. APPOINTMENT.—Capt. G. C. Edwards, R.C.N., is to become Deputy Assistant Chief of the Canadian Naval Staff (Air and Warfare) in August. Loaned to the Royal Navy in 1940, Capt. Edwards commanded No. 824 Sqn. in 1944 and was Director of Canadian Naval Aviation from 1955 to 1957.

R.C.A.F. APPOINTMENTS. — Air Vice-Marshal D. M. Smith, chairman of the Canadian Joint Staff in London, is to become Vice-Chief of the Canadian Air Staff in June in succession to Air Vice-Marshal C. R. Dunlap. As recorded last week, Air Vice-Marshal Dunlap has been appointed Deputy Chief of Staff (Operations) at SHAPE.

LOCKHEED SALES.—Mr. James E. Boyce has been appointed to the new position of director of Lockheed airline and military sales in Australia and the Far East. He was formerly sales executive of the company's California division, and will now be stationed in Sydney.

AIRCRAFT EMPLOYMENT.—During February, there were 254,500 people employed in "the manufacture and repair of aircraft." This figure compares with 256,400 in January, 1958, 266,000 in January, 1957, and 250,000 in January, 1956.

CHESTER R.Ae.S.—May 31 has been selected as the date for the aeronautical show and garden party of the Chester Branch of the R.Ae.S., to be held at Broughton, near Chester. It will be opened by Sir Arnold Hall at 14.30 hrs. There will be static and flying displays and exhibitors' stands. Tickets cost 5s. for adults and 2s. 6d. for children under 15. It is expected that more than 1,000 people will attend.

TEXAS PRESIDENT.—Mr. Patrick E. Haggerty, chairman of Texas Instruments, Ltd., of Bedford, has been elected president of Texas Instruments, Inc., parent company of the wholly owned British subsidiary, with headquarters at Dallas, Texas.

VULCAN PILOT. — Mr. Osborn J. Hawkins has joined A. V. Roe and Co., Ltd., as a test pilot. He was formerly engaged on Javelin development testing with the Gloster Aircraft Co., Ltd.

B.O.A.C. RETIREMENT.—Mr. Frank Saunders, M.B.E., M.I.Mech.E., A.F.R.Ae.S., at present holding the post, special duties to the chief engineer of B.O.A.C., has decided to leave the Corporation. He has spent the greater part of his career in various capacities with the engineering staffs of Imperial Airways and B.O.A.C. for the last 35 years. He was previously in the R.N.A.S. and so has had 42 years in aviation. He is now free to assist the industry in a consultative capacity on equipment design or organization.

NAVAL OCCASION.—On May 8 the captain and officers of H.M.S. "Victorious" gave a dinner to representatives of various firms who had made presentations to the ship's wardroom. Seen in these photographs are some of the guests. Left to right, Mr. D. Menzies (Fairey Aviation); Surgeon Cdr. W. Hawkins (Principal Medical Officer); Mr. C. H. Chichester Smith (vice-chairman, Fairey Aviation); Commander J. A. R. Troup (Executive Officer); Mr. D. O. Thurgood (Fairey Aviation); Cdr. B. Tippets (Electrical Officer); Capt. H. H. Traill (services manager, Westland Aircraft); Cdr. G. Henderson (Supply Officer); Mr. D. C. Collins (works director, Westland Aircraft); Lieut. Cdr. J. H. S. Pearce (Lieut Cdr. Flying); Cdr. S. J. A. Richardson (Cdr. Air); Mr. Marcel J. Lobelle (director and chief designer, M.L. Aviation); Mr. E. N. Mobbs (director, M.L. Aviation) and Lieut. J. Eagle (Flight Deck Officer).

AIR TRANSPORT

Atlantic Traffic Trends

THE first four months of a year do not constitute a typical traffic-testing period for the North Atlantic, but figures released last week by the International Air Transport Association are, nevertheless, interesting.

The most recent of THE AEROPLANE'S series of charts and tables designed to assess the trends in North Atlantic traffic appeared in the issue of May 9 (p. 646) and compared the fourth quarter of 1957 with previous periods going back to the third quarter of 1956. Similar statistics for intra-European operations appeared in the issue of May 2 (p. 615).

IATA's total figures for the first quarter of 1958 show that 4.7% more passengers were carried than in the same period of 1957, but that the capacity utilization was considerably reduced. The average load factor, in fact, was 53% by comparison with 61.5% for the first quarter of 1957.

A total of 159,151 passengers were carried on 5,113 flights—112,356 on tourist and 46,795 on first-class services. Seats available on the services showed an increase of 23%, a reflection—when compared with the 20% increase in the number of flights—of the increased capacity provided by new aircraft types on the route. Cargo was up 3.2% to a total of 5,090,021 kg. carried, and mail was up 15.6% to 2,449,005 kg. There were 467 all-cargo flights.

Total passengers flown eastbound were 73,867 and 85,284 flew to North America from Europe.

Re-equipment in Australia . . .

ACCORDING to a correspondent, the Australian airline re-equipment crisis took an unexpected turn on May 9 when the principal figures involved were summoned into a "let's talk it over" conference presided over at Canberra by the Prime Minister, Mr. R. G. Menzies.

The result, announced later by Mr. Menzies, was that Trans-Australia Airlines and Ansett-A.N.A. would hold re-equipment talks aimed at "avoiding a multiplicity of types." It has been reliably reported that the airline representatives at the conference were told they must develop more uniform fleets in the interests of economic stability in the industry.

The tone of the conference is regarded as showing a fairly clear indication that if the two airlines can reach agreement on the adoption of one type of aircraft, applications by both airlines for import licences for either Caravelles or Electras would receive favourable consideration. Previously, T.A.A. had sought licences for two Caravelles and Ansett for four Electras. Both requests were denied in a Cabinet decision which set off heated discussion on how much say the Government is entitled to have in airline re-equipment policy. The Cabinet, at the same time, clearly indicated that it would favourably consider applications by both airlines for Viscounts. The private airline, Ansett-A.N.A., voiced an emphatic "no" to this suggestion and the Government airline, T.A.A., has, on the other hand, shown no indication that it will take up the Government's offer.

. . . and in New Zealand

LATEST information on the Qantas-Tasman Empire Airways re-equipment issue suggests that Qantas will get four Electras and TEAL three—the last-mentioned to be registered, based and maintained in New Zealand.

An official statement has yet to be issued on the recent inter-Government talks at Wellington—the decisions are still subject to full New Zealand Government ratification—but the broad picture appears to be as follows:

TEAL's three Electras will be given greater utilization than would be otherwise possible by chartering to Qantas, who will use them to supplement their own Electras on secondary routes—notably through the Far East to Hong Kong. TEAL's status as "New Zealand's international airline" will not be affected, despite Australia's 50% share in the airline and the fact that she will pay half the cost of the TEAL Electras and spares. Australia will accept half the loss on the New Zealand service to Tahiti—which offers possibilities for a future air link with America—and will consider easing New Zealand's airport development burden by taking over part of the New Zealand share of developing Nandi, Fiji. Qantas will be given rights to operate one of its trans-American round-World flights each week via Auckland and Fiji, starting with L-1049s and switching to Electras later to form a parallel Qantas-TEAL feeder service between Australia and Fiji, via Auckland.

From the facts available, writes a correspondent, it appears that one of the biggest factors in New Zealand's acceptance of the Australian argument against Comets was the economic background of TEAL itself and the already heavy financial commitment of New Zealand on airport development. Another was undoubtedly the prospect of future joint re-equipment with Qantas when the time comes for adoption of a D.H.121-class turbojet.

Continental's Viscounts

TWO of Continental Air Lines' 15 Viscount 812s are now in the United States and the type is due to go on to the routes on May 28—with an inaugural service on May 27. The 812s will be put first on the Chicago-Kansas City-Denver-Los Angeles and Chicago-Denver-Los Angeles services.

As already announced (THE AEROPLANE, May 2, pp. 614-615) the Viscount 810 Series now has its C.A.A. Type Certificate and its British C. of A. These certificates cover higher maximum weights than those on which the contract specification was based.

The new figures are: maximum take-off weight, 69,000 lb. (previously 67,500 lb.); maximum landing weight, 62,000 (60,000 lb.); and maximum zero fuel weight, 55,500 lb. (54,500 lb.).

Photograph copyright "The Aeroplane"

NIGHT SCENE.—This picture of London Airport's central area at night is interesting because it was taken using a fairly normal exposure with a new type of very fast film.

A Civil Doppler Navigator

AS recorded in our previous issue, Marconi's Wireless Telegraph Co., Ltd., has recently completed a European demonstration tour of its AD 2300-series Doppler navigator equipment for civil aircraft. This is the first commercial Doppler navigation aid to be demonstrated in flight and the equipment, which was installed in an Airwork Viking, had the aerial mounted in a radome under the fuselage, and the other units—transmitter/receiver, tracking unit and the indicator drive unit—were in the forward part of the cabin.

A Doppler demonstration panel, which is in no way a prototype of the production unit, was mounted below a flight-instrument display, so that during the demonstrations the readings of both sets of instruments could be compared. The Doppler demonstration unit also contains a computer, the output of which is displayed as Northings and Eastings.

Although developed from the company's military navigation aid—the AD 2000, which was described in THE AEROPLANE of July 19, 1957—the new equipment contains a number of improved technical and operation features. The main change in design is the use of a continuous-wave beam in the transmission of the electromagnetic signals in place of the pulse system in the AD 2000 series, and automatic signal search, lock-on and memory to eliminate the necessity for the equipment to be monitored and controlled by a crew member. The use of a continuous-wave beam reduces the power required by the transmitter and lowers the minimum operating altitude to 50 ft.

To cover the varying civil requirements for navigational information, three types of equipment have been developed within the AD 2300 series. The first—AD 2300A—consists only of the basic Doppler sensor and provides information on groundspeed, drift angle and miles flown. It has a total weight of under 100 lb.

Second of the three types is the AD 2300B which incorporates a computer as well as the sensor to provide track guidance to the pilot or auto-pilot. Information given by this system includes groundspeed and drift from the sensor; miles to go along the selected leg; error in miles across the selected leg; and total miles to go to destination. The flight plan can include a number of legs, two of which can be set up on the control panel.

In addition to the above outputs, the larger computer in the third system (AD 2300C) provides comprehensive navigation information. Besides track guidance described for the previous instrument, this computer gives the aircraft's continuous position in latitude and longitude; wind speed and direction; and automatic feed-in and display of magnetic variation.

Accuracy and Performance

The first system is stated to have an instrument accuracy such that the groundspeed and distance flown are indicated to within 0.5%, and the drift angle to within ¼°. For the two systems incorporating computers the position accuracy is stated to be within 1% of the distance flown when the heading reference input is to within ½°. A roller map presentation of the aircraft's track can be installed with the two last-named systems.

The aerial is pitch-stabilized for angles of climb or descent up to 10°, and errors caused by angles of pitch exceeding this range are stated to be only of second order. Pitch stabilization is obtained by the use of Doppler signals, and the radiating elements of the aerial are tilted until the forward and backward Doppler frequencies are equal, when the system is aligned along the direction of flight without the use of pendulum or gyroscope reference.

As in the earlier Marconi equipments, the drift angle is found by rotating the aerial system about the fore-and-aft axis of the aircraft until it is aligned with the aircraft's track. The difference or number of degrees between the two headings is the drift angle, which can be measured up to 30° to port or starboard. The AD 2300 series can operate over an altitude range of 50 to 50,000 ft. at groundspeeds from 80 to 900 knots at angles of bank up to 20°.

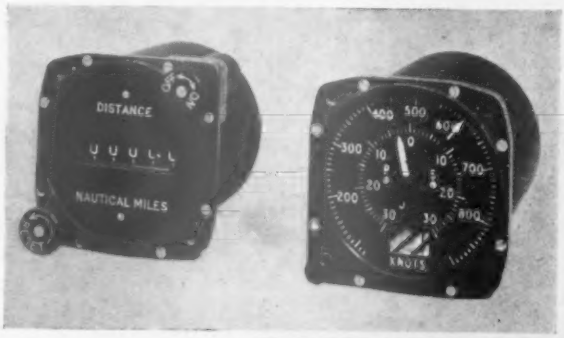
Flying on one of the demonstration flights from Blackbushe we were able to study the new navigator in operation. A triangular course via Dunsfold and Eastleigh was flown so as to eleminate compass error and the 45-min. demonstration covered 106 miles in fairly turbulent conditions.

Once airborne, the readings of the computer in Northings and Eastings were recorded over the end of the runway to check the accuracy of the equipment at the end of the flight. The flag alarm, indicating that the equipment was on "memory," disappeared within seconds of the Viking taking off and the indicators displaying groundspeed, drift in degrees to port or starboard and distance flown, started to operate.

On the first leg to Dunsfold the aircraft climbed on course to between 6,000 ft. and 7,000 ft. and the groundspeed and drift indicator showed rapid changes of drift and groundspeed with the continuous wind variations. During the second leg to Eastleigh the aerial pitch-stabilizing and memory systems were demonstrated in a number of manœuvres including a 45° banked turn through 360°.

Other operating capabilities of the equipment were shown by reducing the aircraft's airspeed to 100 knots and by a low-level run over the airfield at 50 ft. To illustrate the operation of the automatic search and lock-on systems the groundspeed input was moved by a manual override to 700 knots and then released, when the indicator returned to the original figure.

At the start of the flight the Northings and Eastings readings were 55.65 and 75.45 and at the end of the demonstration these were 57.05 and 75.25 respectively. Over the total ground distance of 106 miles this represents an abnormally large error of approximately 2%. During the series of demonstration flights over the Continent the average error was 0.3 to 0.6% of the distance flown.—P.R.R.



Above, the display instruments for the AD 2300A system, the left-hand meter shows distance flown and the other indicator displays groundspeed and drift angle. Right, the Marconi Doppler navigator demonstration units mounted below a flight instrument display.

B.O.A.C.'s Plans for the Future

A NEWSPAPER story which appeared early last week—in which it was said, among other things, that all B.O.A.C.'s piston-engined aircraft would be out of trunk-line service by the end of this year—should, perhaps, be qualified and corrected for the record.

First of all, it is certainly true that the Corporation is considering the use of Comet 4s on the North Atlantic, but whether this plan comes to anything (and before the end of this year) naturally depends on the results of development flying and on deliveries. With Pan American due to introduce Boeing 707-120s on this route in November such a move would be an excellent one from the prestige point of view, if for no other. The service would need to be flown with a refuelling stop at Gander, at least on the westbound run—but the same limitation will apply also to P.A.A.'s 707s.

If all goes well a weekly Atlantic Comet service will be introduced on December 1 and possibly a daily Monarch-class service on January 1.

As for the withdrawal of piston-engined equipment this will be well in progress during 1958, but the Douglas DC-7Cs will certainly be retained on trunk-line services. Even if they are taken off the North Atlantic run Stratocruisers will continue to be used on the W.A.A.C.'s services to and from West Africa and some DC-4Ms will presumably be retained for the same kind of services.

Intra-African Freighting

ACCORDING to a South African correspondent, the day is foreseen in aviation circles when freighters will carry big loads of perishable foods from Southern to Equatorial Africa on regular services. Consignments of eggs, fish, fresh vegetables, meat, fruit, cut flowers and day-old chicks are already being flown—when passenger loads permit—but the surface of the trade has hardly yet been scratched.

Fresh foods first took to the air, our correspondent says, for Equatorial Africa in 1948, when a Pan American employee in Leopoldville asked a visiting friend to send him fresh eggs on the next aircraft. He was tired of frozen and powdered eggs. What began as a favour became a trade.

Now P.A.A. carries a ton of perishables on each northward flight to Leopoldville and Accra, Ghana. South African eggs can be bought as far afield as Liberia—and though they might cost 5s. each, at least they will be fresh. The commercial manager in Southern Africa for Union Aéromaritime de Transport said recently that he would like to see trade missions exchanged between South Africa and Equatorial Africa. He insisted that, so far, the trade has been haphazard, and considered that it should be planned. By 1960, when U.A.T. is operating the DC-8 and Sabena the Boeing 707, there may be up to 10 tons of freight space available between Johannesburg and Brazzaville or Leopoldville.

K.L.M. is also sharing in the perishable traffic, and has pioneered a new one (in bulbs) to Holland and other countries in Europe. South African Airways is also carrying large quantities of perishables to Leopoldville and to Nairobi.

COMPARATIVE U.S. TRANSPORT FATALITY RATES

	Pass. Miles (million)	Pass. Deaths	Fatality rate per 100 million pass. miles		
	1957 (estimated)	1957	1957	1956	1954-56 (average)
Scheduled domestic air transport	25,500	31	0.1	0.62	0.6
Scheduled international air transport	5,800	36	0.6	0	0
Non-scheduled air transport	800	0	0	0	0.6
	1956	1956			
Passenger trains ..	28,190	57	—	0.20	0.07
Inter-city buses ..	51,500	80	—	0.16	0.14
Automobiles and taxis	970,000	26,100	—	2.7	2.7

This table—from information given in a similar table published by the Aviation Safety Center at Cornell University—shows the improving trends in the accident rates in U.S. air transport. The fatality figure for overseas operations was the result of a single ditching accident in the Pacific.

Hold-up in India

THE report from a correspondent, published in THE AEROPLANE of March 21 (p. 384), to the effect that the Government of India has decided to lengthen and strengthen the runways at Bombay, Delhi and Calcutta by the end of 1959, may be correct as the statement of intent—but there appear to be difficulties.

Although it was true to say that work had actually started on a runway extension at Bombay's Santa Cruz Airport—where, following Air India International's order for Boeing 707-420s, the need is presumably greatest—this work has, we are told by Wg. Cdr. Vaughan-Fowler, editor of *Indian Skyways*, been made possible only at the expense of similar work at Dum Dum Airport, Calcutta.

Funds were not available for simultaneous extensions at both of these airports and Calcutta, in spite of its 20 international airline users, has been the unlucky one. Whether or not it will be found possible to complete the work at Dum Dum later and in time for the turbojets is questionable. If not, then Calcutta may be expected to lose traffic to other centres and possibly even to other countries.

As for Palam Airport, Delhi, this is owned by the Indian Air Force and there is an age-old dispute about its future. The Air Force does not require runway extensions, so is not prepared to pay for them, and the civil authorities do not wish to spend money there so long as there is a possibility that the airlines may be moved to another airport. There are plans for a new civil airport across the Jumna River, about 21 miles from Delhi, but its development would also demand the construction of a new road and of a new river bridge. According to Wg. Cdr. Vaughan-Fowler, no work on the proposed new airport site has yet been done and there are, so far, no funds available for such work.

EAST GERMAN JET TRANSPORT. — The four-turbojet Baade BB-152 transport prototype is seen here on the apron at Dresden's State Aircraft Works. Unlike the model illustrated in the issue of March 21 (p. 395) the prototype appears to have the originally planned undercarriage arrangement, with tandem paired main wheels in the fuselage and retractable wing-tip wheels.

Problems of Inertia Navigation

LAST November a series of papers on Doppler navigation was presented to the Institute of Navigation (see THE AEROPLANE, November 22, pp. 769-770). On Friday of last week (May 16) this symposium was followed by a paper on inertia navigation given by Wg. Cdr. E. W. Anderson, O.B.E., D.F.C., A.F.C.

The paper was essentially a non-technical description of the main principles of inertia navigation and given in simple language. As is inevitable with this type of presentation, half truths and over-simplifications could not be avoided. Indeed, as those who have tried to explain any navigation system in simple terms will be aware, the presentation would have been incomprehensible if all the qualifications had been included.

For this reason, the speaker, while acknowledging the help from his colleagues in the Sperry Gyroscope Company, took pains to absolve them from any responsibility for the presentation. He also paid tribute to various writers on the subject—and, in particular, to Dr. D. E. Adams' paper in the Institute's Journal for July, 1956, and to Dr. W. Cawood's presentation in Paris in May last year.

The first part of Wg. Cdr. Anderson's paper was devoted to descriptions of typical key components—accelerometers, integrators, tacho-generators, integrating accelerometers and gyroscopes. Two types of flotation gyroscope were described, one of which, the single-degree-of-freedom gyroscope, seems likely to be similar to that manufactured by Minneapolis-Honeywell and may therefore be the instrument which the English Electric Company are said to be manufacturing in this country.

The Basic Units

Next, systems were described. It was explained that an inertia navigator consists of two units—the stable platform, which carries gyroscopes and accelerometers and which is the sensing element; and the computer which is the brains of the system. The first system to be dealt with was one to which the speaker referred as the "true inertia system," in which the stable platform consists of three accelerometers stabilized in space by gyroscopes so that accelerations are detected and speeds and distances recorded in three directions at right-angles. Such systems are used for space flight, satellite launching and ballistic missiles.

Since these space-borne vehicles travel along predetermined orbits or trajectories, their computers can be simplified. Furthermore—because without thrust there can be no acceleration and without acceleration the inertia navigation system can add nothing to what it already knows—the system will be cut off when thrust is cut off. The requirement for space rocket or satellite launching, or for ballistic missiles, is therefore only to navigate along what may be called an inertia "gun-barrel" for the period of thrust so that the vehicle emerges at the end with the right combination of speed and position to achieve its orbit or to hit its target. It was pointed out that for the 5,000-mile Russian missiles, with flight times of the order of half-an-hour, this inertia gun-barrel would only cover the first five minutes.

The Thor inertia system was described as an example of the true inertia system. Information released in America suggested that the platform was roughly spherical and about 3 ft. in diameter and mounted three single-degree-of-freedom gyroscopes and three integrating accelerometers. It also appears likely that the computer follows the normal practice and includes a trajectory-error computer into which the ideal values for the inertia gun-barrel can be set. The actual values measured by the inertia navigator in flight would then be compared with these ideal values and the differences used to control the missile.

Discussion of a gravity inertia system for ships or submarines led to an examination of the third type of inertia navigation system, known as the precessed system, which was applicable to aircraft. The large platform subject to accelerations was avoided by attaching the two accelerometers directly to the gyro-stabilized platform and avoiding the intervening gimbals by precessing the gyroscopes. As a result, gravity would act on the gyroscopes always from the same direction, thus removing a major source of error. However, this source of error would be replaced by additional errors arising from precessing the gyros.

The components and systems were illustrated by means of slides, but, for showing the effect of gravity on inertia navigation systems, a large model was used consisting of an accelerometer (from which an arrow protruded if it were tilted) mounted with a gyro and travelling round a large globe. This was used to demonstrate how an error in distance caused by accelerometers or integrators would be corrected by gravity but with a period of 84 minutes. Hence, although accelerometer errors increase rapidly initially, they are limited eventually. The model also showed the effect of gyroscope drift and how this error was, unlike the accelerometer error, cumulative but very small initially.

Characteristics of the Systems

This demonstration emphasised the well-known characteristics of inertia navigation systems. The true inertia system, working for only a few minutes during the inertia gun-barrel phase, makes great demands on gyroscopes and accelerometers owing to the high speeds involved, but the demands on accelerometers are particularly severe. The inertia system for ships and submarines made very severe demands on the gyroscopes as it had to operate for long periods and, therefore, it might well be corrected by stars which could realign the gyroscopes. This was the astro/inertia system. The precessed system used in aircraft made severe demands on accelerometers or on gyroscopes, according to whether it had to maintain its accuracy for minutes or for hours, and might well be corrected by a Doppler navigation system.

In America these three systems are given different names. The true inertia system is known as an "analytic" system and the gravity inertia as a "geometric" system, while the precessed system is known as "semi-analytic." Presumably the choice of names for the systems in this paper was based on an attempt to be as descriptive as possible. Certainly the term "precessed system" is much more descriptive and probably more accurate than the term "semi-analytic system," since, although similar in appearance to the analytic, the working is much more like the geometric. True inertia also seems to be a reasonable description, but "gravity inertia" is weak since all inertia systems are affected by gravity in the same way. Nor is the term "five-gimbal-system" acceptable since—as is shown in the written paper, but not dealt with in the shortened version presented by Wg. Cdr. Anderson last Friday—an additional gimbal may be needed.

Effects of the Earth's Rotation

In the course of the paper, a number of curious facts emerged. First it was made plain that, in spite of all the textbooks on navigation, a Great Circle is not the shortest distance between two points on the Earth. The Great Circle would be the shortest distance if the Earth did not rotate and is effectively the shortest time-path for vessels travelling in the air or on the sea because the air and the sea rotate with the Earth. Nevertheless, the shortest distance between two points depends on the speed at which we travel and the slower we go the more curved is the path of shortest distance.

It was also mentioned that, owing to the rotation of the Earth, a missile can be fired further eastwards than westwards. The difference is quite appreciable—a figure of 500 miles in 4,000 miles was quoted. This may provide some small comfort and will come as no surprise to those who flew in Bomber Command. Those forebears of the ballistic missile were always complaining that it took longer to come back from Germany than it did to get there!

The speaker ended by remarking that inertia navigation exemplified the general engineering problem. Electronics had reached a high pitch of efficiency, but transducers, the instruments that translate physical quantities into electronics, had lagged behind. The modern engineering problem was largely a matter of transducers—and the modern inertia navigation problem was largely a matter of the inertia transducers, the gyroscopes and the accelerometers.

The Case Against

NATIONAL SOVEREIGNTY IN SPACE

THE flurry of legal argument engendered by the launching of the first Sputnik seems, to outward appearances, to have died down, but there is the danger that discussions on the problems of outer space to which it rightly gives rise may, so to speak, go underground and emerge later on with conclusions which might have a close bearing on the future of international air transport, serious results for the aeronautical community, and dire consequences for mankind.

The aeronautical community has a special concern, for it comprises those who will make and launch the vehicles and missiles to penetrate outer space and the airmen who, without doubt, will be the first men to travel outside the airspace. The danger which confronts us all is the extension of the concept of national sovereignty into space. In the airspace, national sovereignty is universally recognized and has been since it was established in the second decade of this century. It is, we believe, the duty of the aeronautical community to bring its practical knowledge and experience to bear to ensure that the development of a regime of order in space is based on practical necessities and not on theoretical legal principles.

The Parallel of the First Air Decade

That there is need for this caution is abundantly clear when one observes how closely the pattern of current explorations of the "law to be" in space follows that of half a century ago in discussions of the "law to be" in the air, and how even the same mistakes repeat themselves. To begin with, the public correspondence on the subject appears all to have been contributed by lawyers. Some have made a close study of this particular problem and, moreover, have devoted years to practical work in air law. This is not true of all, and we want to make the point that this is not just a lawyer's problem.

From the beginning of the century until 1910, international lawyers debated and evolved legal theories around the opposing doctrines of "freedom of the air" and sovereignty of the State in the airspace above its territory. The concepts then evolved had each in turn to be revised and discarded as they rapidly became outdated by the practical achievements and knowledge—which even at that early stage crowded upon us. The leading aeronautical journal of the United Kingdom, reporting some of these debates, complained that no practical airman had been consulted. There were more lawyers than airmen in those days.

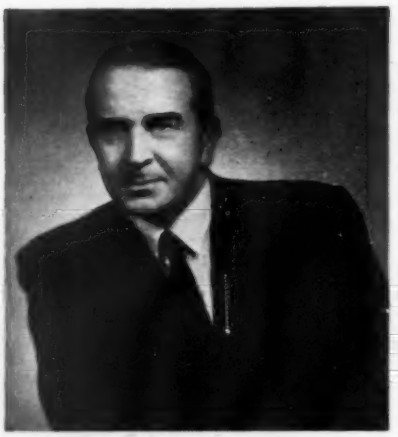
Zone Theories

Zone theories were popular in those days. Recognizing that a country had a more intimate concern with the air in the lower levels over its territory, many legal authorities divided the air into upper and lower zones with differing legal status. While differing in legal concept, the most common effect was to give the subjacent State sovereignty in the lower zone, but with some obligations to permit air traffic; and to give the State certain rights for its protection in the free-zone above. Ideas as to the height of the lower zone varied from 50 to 1,500 metres, and were related to the height of buildings, the vertical range of artillery, the range of photography, and the best height of flight. (It was asserted that it had been conclusively demonstrated that both aeroplanes and airships required a lower level than 1,500 metres for their natural and effective circulation.) The zone theories foundered on the demonstrated unreality of a fixed dividing level; and proposals for a flexible level, based on current achievement (e.g., the range of artillery), proved equally unacceptable.

British Government Action

The issue was settled by the action of the British Government at the International Conference on Aerial Navigation at Paris in 1910, when, refusing to concern itself with theoretical legal principles but only with necessary and practical measures, it virtually declared its intention of assuming sovereignty in the whole airspace over the United

(*Continued on page* 713)



Sir William Hildred

The practical impossibility of establishing national sovereignty in space is set forth by two figures eminent in the international world of air traffic and aerial navigation. Sir William Hildred, C.B., O.B.E., M.A., has been director-general of I.A.T.A. since 1946. Sir Frederick Tymms, K.C.I.E., M.C., F.R.Ae.S., Master of the Guild of Air Pilots and Air Navigators, a former director-general of civil aviation in India, is an authority on international air navigation.

Sir Frederick Tymms

(*Continued from page* 712)

Kingdom. This was done in the Aerial Navigation Act of 1911. The rest of the World promptly followed suit. While British lawyers had long argued for this principle, the decision came when the airmen and practical administrators took over.

It is worth noting, in passing, that the sovereignty principle was propounded, accepted and first put to the practical test for purposes of national defence. That purpose remains basic, but it is fairly safe to say that few, if any, at that time had any conception of the controversial economic principles which have grown out of the exercise of sovereignty, which rule commercial aviation today, and which differ so profoundly from the principles under which sea commerce is carried on.

'Unreal Bases of Reasoning

Of the lawyers who are now conducting a comparable debate, it is true that the majority declare themselves against the admission of national sovereignty in space, but for a variety of reasons, some of which are scarcely convincing. Some consider it impracticable because national frontiers projected into space would overlap, others because they would diverge and leave unclaimed space in between. A schoolroom globe would put those notions right. Some have found it necessary to produce elaborate legal argument that national sovereignty in space does not already exist—as if it depended on some esoteric legal principle. It does not. It is a self-evident fact, for up to now man has had no place in space, and no law or international agreement has touched it.

Of those who argue, wittingly or unwittingly, for the exercise of national sovereignty in space, few go so far as to suggest the extension of the " law of discovery " to the moon, the planets and beyond. The gods of old had their ways of punishing presumptuous man. Beware the fate of Icarus! These fantasies will be dismissed by right-thinking men, but they are none the less dangerous.

The greatest danger, however, springs from the theories woven by those who profess to accept the principle of limiting sovereignty to the airspace, but whose theories contradict it and, like those of 50 years ago, fail to find a stable level supported by technical achievement and capable of practical application. They are more dangerous because more insidious. Among the theoretical solutions tentatively advanced, the principal are these:

(1) A level (or height) within or outside the atmosphere, to which national sovereignty extends, should be fixed.

(2) A contiguous zone in space should be defined, within which the country below should have restricted sovereign right for the control of space vehicles or missiles launched from or approaching neighbouring countries.

Now, these are precisely the theories on which ten years were spent by the jurists debating sovereignty in the airspace. Failing to find a stable and relevant level in the height of the Eiffel Tower, the vertical range of artillery or the height at which an aeroplane would fly, they were eventually forced to retire in the face of the practically imposed solution that the whole airspace is subject to the sovereignty of the subjacent state. Simultaneously, all the elaborately varied codes of law proposed for two or more horizontal zones collapsed and disappeared. Why should we go through all this again? The factors on which it is proposed to determine the altitude of the limits of sovereignty and partial sovereignty are no more revelant than those erroneously applied 50 years ago, and the elaboration of zones is no more necessary for practical purposes than it was then.

Definition of the Airspace

A number of lawyers say it is now necessary to define the " airspace." For the ordinary man, it defines itself, as it did for those who first used it, when it was found that the relevant matter at issue was not the air but the space in which air exists. If it is meant to define it in quantitative terms, we know that it cannot be done. Some argue that sovereignty in the airspace was always intended to apply only to that part in which the atmosphere is sufficiently dense to support an " aircraft." There is nothing in any international convention or in the records of any of the international conferences concerned, down to Chicago (1944), that indicates any such thing. One might suggest that there is confusion here with the practical exercise of a legally recognized right.

The vertical extent of the airspace which is used and in which some control is exercised by the subjacent State has increased year by year since 1910, and during all this time the variation from one country to another has been enormous. Yet even the smallest and least developed country has had its sovereignty in the whole of its superincumbent airspace recognized. Whatever one may think of national sovereignty in the airspace, its universal application to the whole airspace, as distinct from a portion of it, has caused no international difficulty. Nothing has happened to change this. To substitute for it an unfixed element, increasing from time to time and possibly even varying from country to country, would serve no practical purpose, whether for aircraft or spacecraft. But it could create incredible chaos and legal disputation and could set the international air transport industry back for years.

Professor Cooper of Princeton proposed, at one stage, that the limit of national sovereignty should be extended upwards to 300 miles above the earth's surface. On September 2, 1957, in a letter to *The Times*, he stated that this should be revised to 600 miles, because of the altitude reported to have been reached by the Russian intercontinental ballistic missile which had just been launched. That these limits were conceived to be outside the airspace is shown by the form of the proposal " to extend sovereignty upwards "; also by the fact that they are related to the performance of a missile—not an aircraft. These limits are presumably now due to be doubled or trebled by reference to the launching of the Russian and American satellites. It is no more possible now than it was 50 years ago to establish spatial limits for the application of international air law by reference to current technical achievement. The significant difference now is that, once having embarked on the concept of sovereignty in any part of space outside the airspace, there is nothing to stop it extending to infinity.

A Contiguous Space Zone

As to the need for a contiguous space zone of restricted national sovereignty (whatever its dimensions may be), the launching and the approach to Earth of a spacecraft may obviously affect neighbouring countries, both while it is in the airspace and while outside it. The proposed contiguous zone in space appears sometimes to take the alternative form of that zone of the airspace where the air is insufficiently dense to support an aircraft but yet imposes drag on a moving body. This is a difference which is certainly of vital importance technically, but it is difficult to see what bearing it has on the forming of appropriate laws.

The régime of international law to be established must protect all countries likely to be affected at any stage of the launching, flight and landing of a spacecraft. It must take account of national sovereignty in the airspace, because that sovereignty is already established; and it must be independent of the concept of national sovereignty in space, where it cannot be established. No practical difference of conditions seems to call for the creation of a hybrid intermediate zone carved out of the airspace below and space above. Such artificial complications must be avoided.

Practical considerations lead to the conclusion that the establishment of national sovereignty in space would be not only impracticable but that it is unnecessary. It is unnecessary because it would serve no purpose. The potential of a craft (or missile) at a very great height above the Earth's surface to affect the interests of the people on the surface is not, like that of an aircraft in the lower levels of the atmosphere, limited

to the area immediately below. This is ceasing to be the case, even for aircraft at the heights which have now been reached.

Stand-off bombs and photography are obvious illustrations of a warlike character, but increasing speed and height, with the increasing uncertainty of visual perception of position, make the existing national frontiers in the airspace at great heights less and less relevant or effective for the control of peaceful flight. Beyond the airspace, the imagined frontiers would seem to be neither relevant nor effective for any practical purpose. The necessary solution to protect mankind against his own new activities in space must be drawn from another source than the partition of space among nations.

Parallel of the High Seas

When that solution has been practised for centuries on the high seas and for nearly half a century in the airspace over the high seas, it is a matter for great wonder that anyone should have found it necessary to consider a solution based on national sovereignty in space. No country has found it necessary to propose to take sovereign control of the Atlantic Ocean or the Pacific Ocean for its own protection or the better control of peaceful traffic. Setting aside precocious claims, made for economic or other ends, to vastly extended off-shore rights, which have been the subject of recent discussion at Geneva, the World has been content to share equally in the navigation of the high seas, both by military and non-military vessels and aircraft; their conduct is regulated by international agreement and convention. The potential effect of the action of craft, on or over the high seas outside territorial waters, is just as great as will be the potential effect of spacecraft outside the airspace.

International law in space must, as in the case of the high seas, be based on the responsibility of every State for the actions of its own national (i.e., owned or registered) spacecraft and the conduct of its own missiles. Of course, if President Eisenhower's proposal to restrict the use of space to peaceful purposes becomes effective for the whole World, then half this problem would disappear. This, in effect, implies a non-national régime in space, but there would be no certainty that national claims would not be made for other reasons, and those who are concerned with civil aviation would still have to deal with the economic and other civil aspects. The analogy with the high seas is in no way vitiated by the fact that the same analogy applied to the airspace, in the early discussions referred to, fell to the ground. That analogy failed because of the inseparable association of the air in its lower levels with the land over and around which it lies, and because of the impossibility of finding any logical or practical dividing line between the upper and lower levels of the atmosphere.

Some appear to find the only alternative to partitioned sovereign control of space to be the vesting of control in the United Nations or some such international body. Apart from the thought that it might be better to try out World government on earth (or a part of it) first, it is not easy to see why we should go beyond the analogy of the high seas in the approach to order in space. The task of the international administrators, assisted by airmen, scientists and lawyers, is to work out international agreements for the intelligent and friendly use of space, not for the ownership of, or partitioned jurisdiction in, space.

Having accepted the necessity for one régime in the airspace and another in space, and having recognized the unreality of a precise dividing line, one must consider whether, in fact, the imprecise boundary is likely to be a cause of embarrassment. In doing so, it is necessary to consider also the division between aircraft and spacecraft which it will be found do not remain neatly within their respective spheres. One can see no practical benefit, but only added complication, from the definition of a precise division, which must necessarily be arbitrary between the one and the other.

Boundary Between Airspace and Space

Taking first the boundary between airspace and space, the sea provides no useful parallel. There is no such absolute difference between the high seas and territorial waters as there is between space and the airspace. The basic reasons for the three-mile limit long ago ceased to have any relevance. The limit is arbitrary and has been maintained by most countries to block claims to extension of sovereignty over the seas. Nevertheless, such claims are made—some arguable, some not. Fixing a dividing level, whether in the airspace or outside it, would give rise to similar claims. The essential relevant fact is that the depth of the zone of rare atmosphere, anywhere within which one could say the airspace ceases, is negligible in the scale on which space navigation will be conducted.

The rule of international law in sovereign airspace will necessarily have to give place to the rule of international law in free space, as and when technical circumstances dictate, not at a prefixed arbitrary level. The operation of space craft through the lower airspace must necessarily be co-ordinated with air traffic, and in so far as the airspace of any second country is traversed, must, for that reason and for the protection of its inhabitants, take account of the sovereignty of that country and any control it has established. Beyond the levels at which aircraft operate such subjection to the sovereign control of the country below will rapidly cease to be effective or useful.

We are told that each of the satellites now in orbit, at its perigee, passes through the fringe of the atmosphere; but it would be idle to pretend that the country immediately below at any particular moment could exercise control over it or is affected by it, any more than a number of neighbouring countries not immediately below it. A spacecraft in these conditions must conform to the international law evolved for free space, not for sovereign airspace, whether it is outside the atmosphere or just within it; and this level is far below the fixed level of 300 miles or 600 miles proposed by Professor Cooper. Nothing, however, would be gained by proposing to fix the boundary of sovereign airspace at 120 miles, because those satellites in their orbits today approach to about that distance from the earth. It is the nature of the flight and not the precise spatial position which is the governing factor.

Differentiation of Aircraft and Spacecraft

The other dividing line, between aircraft and spacecraft, is little more clear. Leaving aside ballistic missiles, vertical jet lift craft (of which the Rolls-Royce "Fying Bedstead" is the most familiar example in Britain) having air-breathing motors, can fly only within the airspace. Yet they are not "aircraft." Nevertheless, since they will operate normally in the same medium, they must be subjected to the same measures of control as are aircraft.

To take another example, reports on the North American aircraft "X-15" indicate that it is designed to be both aircraft and spacecraft. In its initial flight path, it will be, at least partially, supported by wing surfaces. It is intended to be placed in orbit round the earth by means of rocket thrust. In its flight through the airspace, it must obviously be treated like other aircraft and, in so far as that part of the flight is international, it must conform to the international law based on sovereign airspace. (This is not to say that this and other supersonic aircraft can be made to conform to the same air traffic rules as those applying to subsonic aircraft.) In the other part of its flight, where national frontier divisions have ceased to be significant, it must conform to the international law to be evolved for free space. It is the nature of the flight and not the instrument which is the governing factor.

Conclusions

We believe that consideration of the real factors in this problem will demonstrate clearly that:—

(1) The exercise of national sovereignty in space is unnecessary for the protection of the interests of any country, because the division of space into national segments would be ineffective for any purpose.

(2) The effective exercise of national sovereignty in space would be absolutely impracticable.

(3) The recognition of national sovereignty in the airspace is something we have to live with for the present, but a practical code of international law does not require a geometric definition of the boundary between airspace and space. Any attempt to define it repeats old errors, is inducive of claims to extended sovereignty, and is dangerous.

We believe that the extension of national sovereignties beyond their present recognized limits would add one more to the causes of conflict in an already overburdened world and must be classed as an evil. The theorizing of unofficial bodies, having no actual responsibility, can only accentuate the danger, and it is to be hoped that responsible governments will not delay too long in making a declaration of their attitudes, as emphatic as that of the British Government in 1910.

THE FIGHTING SERVICES

North American Visit

STAFF and students of No. 16 Specialist Navigation Course, R.A.F. Flying College, Manby, accompanied by representatives of the Air Ministry, Flying Training and Coastal Commands and the Royal Aircraft Establishment, are due to return to the United Kingdom today from a visit to Canada and the United States. Led by Air Vice-Marshal J. Cox, Senior Air Staff Officer, Flying Training Command, the party flew to North America in a Transport Command Comet on May 9.

With the object of studying current techniques and equipment of navigational and weapons interest, the party toured a number of Service establishments. These included the R.C.A.F. Central Experimental and Proving Establishment at Uplands; the R.C.A.F. Central Navigation School, Winnipeg; Wright-Patterson U.S.A.F. Base at Ohio; Eglin Air Force Base, Florida, and the U.S. Naval Station at Patuxent, Virginia.

Ceremonial Cloaks

A CLOAK, made of Venetian cloth, sleeveless, and having four gilt buttons and a neck fastening bearing the R.A.F. badge, has been introduced for optional wear by senior officers of the rank of Group Captain and above. Easier to wear with ceremonial dress than the normal greatcoat, the cloak may be worn by officers travelling to and from ceremonial functions.

Education Branch Dinner

THE 10th Annual Dinner of the R.A.F. Education Branch was held at Over-Seas House, St. James's, London, on Friday, May 9, when 146 serving members of the Branch were present, along with six retired members. The nine guests included Air Chief Marshal Sir Thomas Pike, A.O.C.-in-C., Fighter Command; Air Marshal Sir John Whitley, Air Member for Personnel, and Air Marshal Sir Denis Barnett, Air Secretary. Air Vice-Marshal A. C. Kermode, Director of Education Services, proposed the toast of "The Guests," to which Sir John Whitley replied.

No. 40 Group Tie

A TIE has been designed for wear by officers and airmen who are serving or who have served with No. 40 (Maintenance) Group. Available from T. M. Lewin and Sons, Ltd., 103 Jermyn St., St. James's, London, S.W.1, at a cost of 12s. 6d. in rayon; 15s. 6d. in terylene and 18s. 6d. in silk, the tie has a maroon background with the emblem of the Group badge diagonally superimposed across it.

R.A.F. Aerobatic Teams

FOR the second year in succession the aerobatic team of No. 111 Squadron led by Sqn. Ldr. R. L. Topp, A.F.C., has been nominated to represent the R.A.F. at major flying displays in the United Kingdom and on the Continent. Now based at R.A.F. North Luffenham and re-equipped with the latest version of the Hunter 6 embodying the saw-tooth wing, the Squadron is to visit France, Holland and Belgium during the summer.

The second aerobatic team from the Service this year comprises four Hunting Jet Provost T.1s from the Central Flying School, R.A.F. Little Rissington. Painted in a special red, white and blue colour scheme, the aircraft are from the original batch employed by Flying Training Command for trials in 1956-7 which led to the adoption of the all-through jet training programme for future Service pilots.

Led by Flt. Lt. N. H. Griffin, the C.F.S. team will make its debut at the R.A.F. Association eastern area air display at Hucknall on Whit-Monday, May 26. As recorded in a previous issue, the No. 111 Squadron team will also be at Hucknall, along with Flt. Lt. R. E. Holloway of No. 5 F.T.S., R.A.F. Oakington, who will give an individual aerobatic display in a Vampire. Flt. Lt. Holloway recently won the Wright Jubilee Trophy in the aerobatic contest between the jet flying schools in Flying Training Command.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Group Captains: P. R. Beare, D.S.O., D.F.C., to R.A.F. Tern Hill, to command; R. E. Beeny, O.B.E., to the Air Ministry for duty in the Department of the Air Member for Supply and Organization; R. J. B. Burns, O.B.E., to the Air Ministry for duty in the Department of the Air Member for Personnel; R. H. C. Burwell, C.B.E., D.F.C., to H.Q. Coastal Command for air staff duties; W. Carter, D.F.C., to the Joint Services Staff College as Senior R.A.F. member of the Directing Staff; W. K. Stewart, C.B.E., A.F.C., to the R.A.F. Institute of Aviation Medicine, to command; R. Trippett to H.Q. Bomber Command for administrative staff duties; J. Wallace, D.S.O., D.F.C., A.F.C., to R.A.F. Bawdsey, to command; G. P. Harger, O.B.E., D.F.C., to R.A.F. Horsham St. Faith, to command; H. E. Hopkins, C.B.E., D.F.C., A.F.C., to Headquarters, Home Command, for air staff duties; T. S. Kennedy, O.B.E., to Headquarters, Fighter Command, for administrative staff duties

Wing Commanders: E. A. Cox to R.A.F. Wattisham for technical duties; S. A. Fentum to H.Q. No. 24 Group for technical staff duties; F. R. Flynn, A.F.C., to H.Q. Flying Training Command for accident prevention duties; E. D. Green to the Air Ministry for duty in the Department of the Chief of the Air Staff; B. J. Jennings, A.F.C., D.F.M., to R.A.F. Cardington Balloon Unit, to command; F. N. Shuttleworth to the R.A.F. Hospital, Halton, as specialist in ophthalmology; D. C. Smythe, D.S.O., C.M., to United Kingdom Service Liaison Staff for Air Staff Training duties in Canada; R. S. C. Cater to Air Ministry for duty in the Department of the Air Member for Personnel; W. C. Clements to Air Ministry for duty in the Department of the Air Member for Supply and Organization; W. A. Cormack, M.B.E., to Headquarters, 2nd T.A.F., as Chief Photographic Officer; W. Kemplay to Air Ministry for duty in the Department of the Air Member for Supply and Organization; H. H. Mayoh to No. 1 School of Technical Training, Halton, for education duties; F. H. Peterson to Air Ministry Unit, Ruislip, as Senior Medical Officer; J. F. Sanders to No. 1 School of Technical Training, Halton, for education duties; J. M. Stevenson to No. 16 M.U., Stafford, for administrative duties

Reunion

W.R.A.F. Officers' Association.—The third reunion will be held at the Victory Club, London, on June 7. Tickets, price 8s. 6d., can be obtained from the Hon. Secretary (Room 437), Air Ministry, Adastral House, London, W.C.1.

RUNNYMEDE MEMORIAL.—The fifth annual Service of Remembrance to the officers and men of the Air Forces of the Commonwealth who died in the 1939-45 War was held at the Runnymede Memorial last week. The wreath this year was laid by Dr. J. E. Holloway, the High Commissioner for South Africa.

Variable Geometry for Aircraft

by J. R. Cownie, B.Sc. (Eng.), Grad. R.Ae.S.

HOW CAN one define variable geometry as applied to aircraft? In the strictest sense it is impossible to do so; even the most rudimentary of aircraft depend for their control on changes in their basic geometry.

But, for the purposes of this article, variable geometry will be taken as referring to techniques less orthodox than those of basic control. Some of the more interesting aircraft which have used these techniques in the past will be surveyed and the case for future applications examined. Attention has been focused on variable geometry recently by the proposals attributed to Dr. Barnes Wallis of Vickers-Armstrongs. His Swallow project, described in THE AEROPLANE last week, uses a variable-sweep wing to reconcile supersonic cruising with reasonable landing characteristics.

Any study of variable-geometry aircraft can profitably begin by considering birds. No flying machine could be expected to vary its basic shape to the extent which even the least sophisticated of birds shows to be commonplace.

An aircraft designer might consider that weight penalties consequent on their variable-geometry systems should prevent birds being able to fly at all. Nevertheless, for all the mechanical complexity of these systems, many birds make long transoceanic migration flights and despite their low take-off weight have an excellent range performance.

The greatest advantage birds have over aircraft lies in their efficient auto-stabilization system. This enables them to operate with configurations which are inherently unstable. Only today are aircraft designers proposing to accept instability in supersonic aircraft if it implies a performance gain.

How do birds vary their geometry in flight? It is fair to say that they do this in every way possible. They can alter the shape and position of their wings at will. Span, area, sweepback, dihedral, incidence, and even wing profile, can be changed to meet the needs of the moment. All changes can be made differentially when manœuvres demand. And not content with such complicated wings, birds possess tails which can be used in the same versatile fashion. Some birds even use their feet as auxiliary control surfaces to supplement their tail area.

Certain species of bird have developed the art of variable geometry to an extreme degree. The fork-tailed falcon, for example, sweeps its tail segments forward so that they lie just behind and below the trailing edge of its wing. They then act as Fowler flaps and increase the lift of the wing.

The tailplanes of birds involve drag penalties. In consequence many species fold their tails to form the rear fairing of their body in cruising flight. For trim forces they rely on alterations in wing profile or sweep.

Most remarkable of all bird achievements is the maintenance of laminar flow over their surfaces which has been attributed to some species. Professor A. Raspet in America has formated a sailplane on soaring turkey buzzards and measured their rate of sink. His results show that the very low drag of these birds can be explained if there is total laminar flow over their wings and bodies. It is thought that they alter their surface shape to produce this result. Should laminar flow break down at any

These studies of seagulls indicate the infinitely-variable shapes which birds can adopt to meet different conditions of flight.

Photographs copyright "The Aeroplane"

Photograph copyright "The Aeroplane"

The take-off and landing of swans makes a fascinating study; a foot-assisted take-off and water-ski landing are seen here.

point it is believed that the bird feels the transition to turbulent flow as a "tickle" and restores laminar flow by suitable muscular action.

Aircraft designers can draw a moral from the achievement of the birds: it is that variable geometry can bring vast performance benefits. In terms of manœuvrability, take-off and landing runs and speed range, most aircraft compare unfavourably with birds. But the sophistication and efficiency of a bird's variable-geometry and control system are never likely to be matched in an aircraft, although no doubt designers would be happy to take up the challenge if a similar development period were acceptable.

Aircraft Background

Since the Wright brothers' first flight, aircraft have adopted increasingly sophisticated methods of changing their geometry. The spur has been the need for higher and ever higher performance.

In the beginning there were only the most basic of controls: elevators, rudder and wing-warping or ailerons. But at this time little more was expected of an aircraft than that it should fly under control with a load consisting only of fuel and a pilot.

As aircraft cruising speeds increased it became necessary to prevent take-off and landing speeds from rising simultaneously. One of the earliest variable-geometry attacks on this problem was the Handley Page slot. In its time this device was widely adopted and even today it has many applications. Use of slots and flaps enabled the Handley Page Gugnunc biplane to fly under full control at speeds ranging between 33 and 112 m.p.h.

Performance requirements soon led to the adoption of wing flaps, retractable undercarriages and variable-pitch propellers —all variable-geometry devices in the strictest sense. In their time all were opposed as innovations not worth the weight and complication they involved—but all duly became standard on high-performance aircraft.

Conservatism has often affected the rate at which different aircraft companies have incorporated variable-geometry devices in their aircraft. A typical example is the airbrake; experience with early jet aircraft showed this to be an essential control. Yet a British swept-wing fighter in service today carries an airbrake which was added only at a comparatively late stage in its development.

It is clear that throughout aeronautical development aerodynamic needs have dictated the adoption of variable-geometry devices. At every stage such developments have been opposed and their practicability questioned; nevertheless mechanical and structural designers have made them possible. For example, even variable-camber wings were successfully developed long ago; they were used on the Fairey IIID, and, more recently on high-performance sailplanes. These have no ailerons, and wing camber is varied differentially for lateral control.

The trend towards performance improvements via variable-geometry will continue. Arguments against such developments are usually based on the weight, complication and cost they involve. But history has shown that such arguments are often invalid because of the outdated assumptions on which they are based. If the aerodynamicists can show that a new technique, such as, for example, variable wing-sweep, will bring sufficiently large gains in performance in a particular application, then the likelihood is that the technique will be adopted.

The variable-geometry techniques so far discussed have been main-stream ones—developments with a wide general application. Others have been suggested and applied over the years to meet specialized needs. Examples are telescopic wings, whereby wing area can be varied to suit flight requirements, and wings with variable-incidence or variable sweepback. Such techniques are likely to be applied more widely in future than in the past.

Variable-incidence Wings

Wings whose incidence relative to the fuselage can be altered in flight have been used on specialized aircraft in the past. They allow the wing to be set to give peak lift for take-off or landing without the fuselage taking an excessive nose-up and high-drag attitude.

Aircraft which have used this technique include the Supermarine Seagull amphibian and the Chance Vought Crusader naval fighter, which is in the same speed bracket as the latest land-based fighters.

Pivot-wing VTOL aircraft carry the variable-incidence

Slots and flaps of the 1929 Handley Page Gugnunc ensured full control at very low speeds.

Full-span slots, large flaps, drooping ailerons and a variable-incidence wing gave the Supermarine Seagull amphibian excellent slow-flying characteristics. In the airborne view it is in the landing configuration; note the difference in wing incidence between the two views.

technique to its limit. Airflow over the wing from the propellers ensures that the wing remains unstalled right through the incidence range.

Variable-sweep Wings

Wings whose sweepback can be varied in flight have often been suggested for aircraft which must operate over a wide speed range. Ever since the advantages of the swept wing for high-speed flight were appreciated designers have been bedevilled by the low-speed drawbacks of sweep.

Variable sweep, however, was applied for other purposes before the days of the high-speed swept-wing aircraft. The Westland-Hill Pterodactyl IV of 1933 had wings whose sweep could be altered in flight through a range of 4¼°. Each wing was hinged about the rear spar and the front spars were joined by a turnbuckle. The pilot used a handwheel to vary the sweep. The wing hinges were inclined so that the wing incidence increased by 1° as sweep was decreased through its 4¼° range. This feature of the aircraft enabled its centre of gravity to be moved through a range of 7 in.

Modern applications of variable sweep aim at combining the advantages of modest sweep at take-off and landing with those of high sweep at near-sonic, transonic and supersonic speeds.

The highly swept and thin wings of modern high-speed aircraft usually have a low aspect ratio. Their maximum lift coefficient is low and developed only at high incidence. Lateral and longitudinal stability is poor at high incidence. Induced drag is very high at low speeds and the glide-path angle is thus steep.

Such aircraft take-off and land of necessity at high speeds. Their wing area is usually dictated by take-off and landing requirements and the aircraft are therefore handicapped by wings whose area and weight are greater than necessary for their high-speed performance.

If the wing-sweep of such aircraft can be reduced for take-off and landing, great advantages follow. In the reduced-sweep position the wing is effectively thicker, the aircraft's stability and control characteristics are greatly improved and the lift coefficient of the wing can be increased by up to 50%.

These advantages are not easily achieved. The main difficulties are the weight and complication of the wing-sweep mechanism and the need to ensure that alterations in the centres of gravity and lift as sweepback changes do not affect control.

On balance, however, advantages are likely to outweigh the disadvantages, particularly as aircraft speeds move farther into the supersonic region. Until now the effective difference between cruising and take-off and landing speeds has been reduced by cruising at altitude. The new generation of jet airliners, for example, will cruise at equivalent airspeeds only about twice as great as those at which they approach to land. But this equivalent airspeed ratio increases greatly for aircraft which cruise at high supersonic speeds—the designer then finds increasing difficulty in reconciling both high- and low-speed requirements in an efficient design.

The Bell X-5

The Bell X-5 mid-wing monoplane is the most interesting application of variable sweepback in recent years. Although intended as a research aircraft, it was designed to a tactical fighter specification so that armament could be substituted for research equipment. In effect it was a prototype day fighter.

Preliminary design began in 1948 and flight-tests started in 1951.* As well as the installation of variable sweepback, the aircraft was designed for minimum size and weight. Its engine was an Allison J35 rated at 5,200-lb. thrust. All-up weight was only 9,892 lb., less than that of contemporary fighters despite its variable sweepback.

Wing area was approximately 175 sq. ft., and varied slightly with the sweep which could be altered in flight between 20° and 60°. As sweep was increased the wing span decreased from 30.8 ft. to 18.6 ft.

Leading-edge slots were fitted to the wings to improve handling at high angles of sweep and to increase lift on landing. Split flaps inboard of the ailerons could be operated throughout the sweepback range. A sliding fillet was fitted at the wing

* (Design of the X-5 was based on the Messerschmitt P.1101 which was still being built when the War ended.—Ed.)

Wing sweepback of the tailless Westland-Hill Pterodactyl IV could be varied through 4½° for trimming purposes.

root to ensure smooth flow despite sweepback variations. The tricycle landing gear retracted into the fuselage.

No figures are available for the weight penalty of the sweepback mechanism and adjustable wing fillet, but it is reported as being "surprisingly low."

The main problem in designing the wing was that of maintaining the aircraft's trim as wing sweep was changed. To do this the wing was moved forwards automatically on the fuselage as the sweepback angle was increased. In addition, as a research feature it was arranged for the wing to be moved fore and aft slightly from its mean position of any angle of sweep. The jacks which operated the sweep mechanism enabled sweep to be changed from 20° to 60° in 30 sec. The construction of the Bell X-5 proves that a variable-sweep aircraft does not present insuperable design problems.

Low-speed wind-tunnel tests on an X-5 model showed that maximum lift coefficient with flaps down varied from 1.09 at 50° sweep to 1.45 at 20° sweep. Its maximum lift/drag ratio varied from 8.4 at 60° sweep to 13.6 at 20° sweep. Thus, assuming peak lift could be used, at 20° sweep the landing speed would be some 13% less than with 50° sweep, the gliding angle would be much better and there would be additional advantages in lateral and longitudinal stability.

Naval Advantages

Variable-sweep aircraft have obvious advantages for carrier-borne operations. In deck landing the relative speed between the carrier and an approaching aircraft is very important—the energy which must be absorbed on landing varies as the square of this speed. A small reduction in approach speed represents a relatively greater reduction in speed relative to a carrier deck.

Of equal importance in naval operation is good control during the approach. Reduction in wing sweep would improve control characteristics.

Wing sweep on a naval aircraft could well be extended to give the effect of present-day wing folding. Naval aircraft are handicapped by wing-folding gear which contributes only dead-weight and consequent performance penalties. Variable-sweep wings could, in effect, be folded; the mechanism in this case would help improve performance.

A Variable-sweep Supersonic Transport?

There is much speculation today about the characteristics of long-range supersonic transports. At what speed should they cruise—M=1.2, M=1.8 or M=2.5? Technical argument rages, but it is interesting to note how airliner speeds in the past have followed closely those of military aircraft. The new generation of jet airliners will cruise at the same speeds as current British and American strategic bombers.

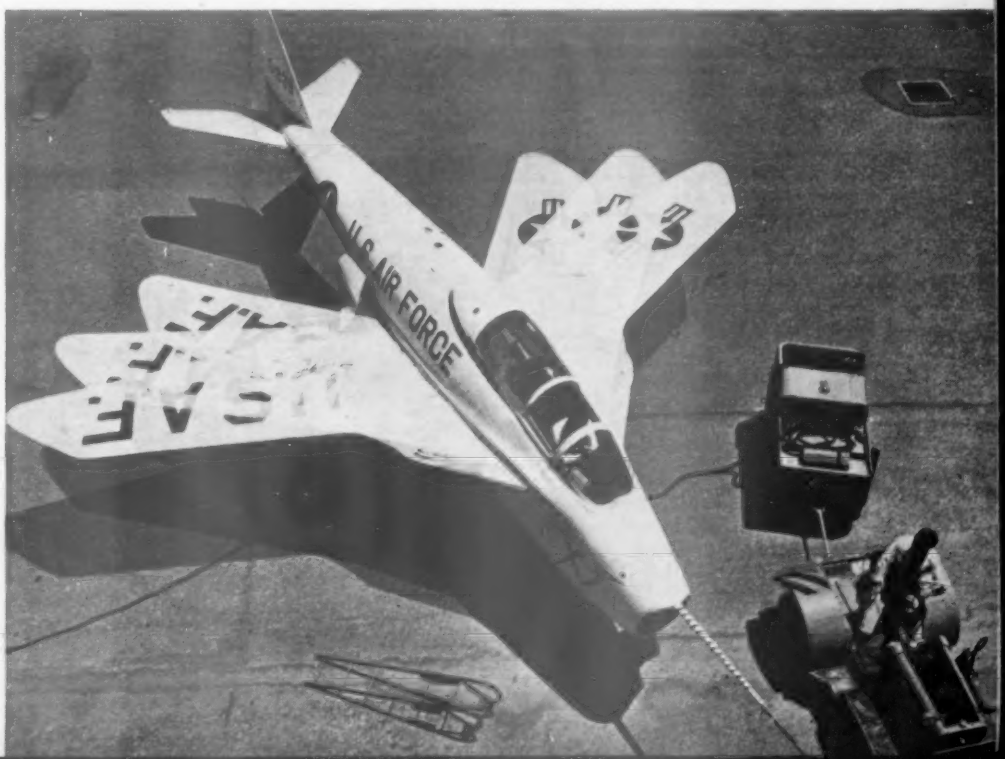
Britain has shelved her plans for a supersonic bomber but America, despite her missiles, is going ahead with the WS-110A project, a long-range bomber to cruise at M=2.0 with a dash performance of M=3.0. Will a new generation of airliners travel at such speeds? Technical studies are being made; operating economics will probably prove the deciding factor.

Clearly the designer's greatest task with such aircraft is to give them reasonable take-off and landing performance. Efficient supersonic flight involves very thin, low aspect-ratio wings and high wing loadings, all factors which militate against low landing speeds. Low aspect-ratio wings have very high induced drag at subsonic speeds and a very low maximum lift coefficient. Their small span also leads to lateral-stability and inertia-coupling difficulties.

An ingenious solution has been suggested. The supersonic transport should be designed solely to meet the cruise conditions; it would have the optimum wing area and aspect ratio for its design Mach number and take-off and landing considerations would be neglected. Such an aircraft, using a lightweight highly-swept delta wing, would have such a light structure weight that for take-off and landing it could carry lightweight high-thrust jet engines, mounted vertically, whose thrust would enable the aircraft to take off and land vertically.

But there are practical drawbacks to this scheme. If the

esent-day application of the variable-ence wing is on the Chance-Vought ader naval fighter (left and below), se performance compares with that of ent land-based aircraft. Wing sweep-of the Bell X-5 research aircraft t) could be varied in flight from to 60°; wing positions are seen in this composite photograph.



vertical-lift engines had a consumption of 1.2 lb./lb. thrust/hr. they would consume at least 2% of the aircraft's all-up weight in fuel for each minute they operate. Engines of this type develop about 10 lb. of thrust for each lb. of their own weight. Thus they must represent at least 10% of the aircraft's all-up weight on take-off and their fuel an additional 2% for each minute the vertical-thrust engines are running. When the aircraft is cruising its payload in effect includes the deadweight of the vertical-lift engines plus the fuel they need for landing.

Clearly the argument for such an aircraft depends on the running time necessary for its vertical-lift engines. It would seem very optimistic to assume that fuel will be needed for less than 3 min. running of these engines at full thrust on each flight if reserves are included. In this case auxiliary engines and their fuel will represent some 15% of the aircraft's take-off weight—allowing for landing at 50% of the take-off weight.

Although such aircraft could take off vertically it is unlikely that they would do so other than at aerodromes because of their noise and their need for supervision by air-traffic control.

Independence of aerodromes may be a necessity for future military aircraft; for long-range airliners there seems limited advantage in VTOL capability, particularly if it involves economic penalties.

In view of this, long-range supersonic civil aircraft would do well to make use of the long runways which will have been built for jet airliners. The aim must be to make them approach at speeds no faster—or lower if possible—than those of the jetliners.

How can this be done? The basic difficulty was stated by Mr. L. F. Nicholson in a recent R.Ae.S. lecture: "The problem in getting a low landing speed from a heavily loaded high-speed aircraft which may well have a moderate or low aspect ratio is fundamentally one of getting enough power to sustain level flight at low speeds. Power must be available to break away during the approach in case of a baulked landing, so that the ability to fly level at the approach speed is a real criterion. . . . No amount of ingenuity expended on increasing the lift coefficient obtainable from a wing can enable us to avoid the fact that large lifts associated with small spans require an excessive power and the only way to reduce the power is to increase the span."

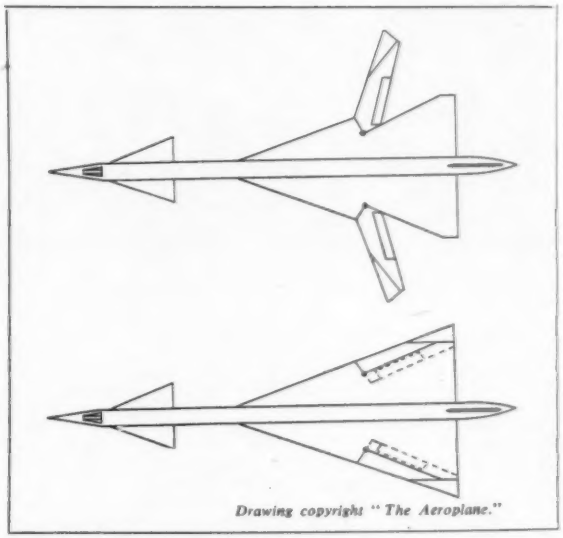
An answer to this is to vary the sweep of the wing—or of a section of it. Such a technique might well be applied to the slim delta wing on which the VTO proposal is based.

The slim delta is an ideal wing shape for the supersonic aircraft. It has a good supersonic lift/drag ratio and the flow pattern associated with it varies only slightly between subsonic and supersonic flight; trim changes are thus small. But, with its leading edge swept within the Mach cone, it has a very low aspect ratio and hence poor maximum lift coefficient and very high induced drag at subsonic speed.

These defects could be eliminated by arranging for a section of the wing to pivot forwards, increasing both span and wing area. An all-moving foreplane could be used for trimming purposes.

This solution is easy to suggest—but it involves formidable design problems. There would be weight penalties, but probably lesser ones than with the jet-lift aircraft. Certainly the variable-sweep solution would give an aircraft whose performance was more flexible than that of the jet-lift airliner and an airliner less subject to split-second timing in its operation.

Typical of the current variable-geometry schemes for VTOL aircraft is the pivot wing of the Hiller 1048.



Drawing copyright "The Aeroplane."

This slim-delta supersonic transport would use variable-sweep wing segments to increase its wing-span for low-speed flight. This would reduce drag, increase the maximum lift coefficient and improve controllability so that the aircraft could operate from the runways used by current jet airliners.

Incidentally, one factor which will help the landing of the long-range supersonic airliner will be its reduced all-up weight on landing. For good range performance 50% or more of the take-off weight must be fuel. If the aircraft were designed for a maximum landing weight which was only 55% of the all-up weight, the landing problem would be lessened.

New Variable-geometry Techniques

Supersonic aircraft are likely to depend on other variable-geometry devices which are now coming into service. A vital one is the variable-shock air intake to the engines. Engine thrust depends on intake pressure-recovery. Movable centre-body intakes can improve engine inlet performance by as much as 80%. Intakes of this type are used on the Convair Hustler supersonic-dash bomber.

Variation in the direction of engine thrust is another technique which is coming into widespread use. An example is the jet-deflection Meteor in which jet thrust is deflected to give a lift component, thereby allowing landing speed to be reduced. Jet reversal is also to be used for braking.

A new application for jet deflection has been suggested in supersonic flight. Inclination of jet-engine thrust line would enable supersonic lift/drag ratio to be increased. In this way it is claimed that fuel consumption gains of up to 15% can be made in the Mach-number range from 3 to 5.

Other variable-thrust geometry schemes depend on jet deflection. Typical is the jet-flap in which the jet efflux is ejected as a thin sheet from the trailing edge of the wing. Another technique which has been proposed is the blowing of a jet sheet sideways through the tips of a low aspect ratio wing. The aim of this is to increase the effective aspect ratio and enable a higher lift coefficient to be achieved.

Variable geometry in the physical sense will be used more widely to increase the view from supersonic aircraft. This trend is illustrated by the hinged cockpit and nose of the Fairey F.D.2 delta. Future supersonic aircraft may have periscopes or retractable visors to improve the outlook of the pilot at subsonic speeds.

The Future

It is clear that variable-geometry schemes in profusion are now invading the aeronautical scene. The convertiplane field gives only one example of the new look in aeronautics. Pivot-wing VTOLs, tail-sitter VTOLs, jet flat-risers such as the Short S.C.1, STOLs such as the Breguet with its wing immersed in the slipstream and large flaps directing thrust downwards—the variety of approaches is astonishing. As in the past, new techniques are needed to bring advances in performance.

Variable geometry will play an ever-increasing rôle in the years ahead. In the supersonic field there is big scope for its application. A long-range supersonic transport with variable-sweep wings may sound improbable today—but who would dare forecast with certainty the shape of the airliners we shall see in 1970?

Noise Characteristics of the Tu-104

This article, by I. RAZUMOV, V. KVITKA *and* G. GUBKINA, *is reprinted, with acknowledgments, from the Soviet aviation magazine, "Grazhdanskaya Aviatsiya."*

LAST year the Government scientific research institute began work on noise produced by airliners with powerful engines. In this article, data obtained for the Tu-104 and Il-14 are compared with the noise characteristics of foreign aircraft published in technical literature.

Measurements were made on the airfield and in districts lying close by. Aircraft Tu-104 L5412 and Il-14 L1465 made flights according to a set programme. Also, noise intensity levels were recorded on the ground during take-off of individual regular-service airliners. All the main measurements were made with apparatus describing both the total noise level and the level in individual octaves in the audible range from 37.5 to 9,600 c/s. Supplementary control measurements of the total noise level were made with a non-selective noise gauge.

The noise was picked up by means of a microphone which was moved round each aircraft (continuous operation of both engines at cruising rating) in circles of 100-m. and 30-m. radius.

Instrument readings were taken at points separated by an angular distance of 20°. For the Tu-104 the centre of the circles was taken as the point of intersection of the longitudinal axis of the aircraft with a vertical plane containing the jet-engine exhausts, and for the Il-14 the point of intersection of the longitudinal axis with the plane in which the airscrews rotate.

During the measurements the ambient air temperature was about −5° C. and the wind speed up to 6 m./sec. with gusts up to 9 m./sec.

Analysis of the measurements shown in Fig. 1 shows that the average values of the total noise intensity level for the Tu-104 L5412 on circles of 100-m. and 30-m. radii are 114 db and 124 db respectively, exceeding the average values for the Il-14 by 14 db.

The noise intensity of the Tu-104 is non-uniformly distributed round the circles. At a radius of 100 m. it reaches a maximum —119 db—at an angle of 40° to the axis of the exhaust-gas stream and a minimum—98 db—in front of the aircraft. On the 30 m. circle the noise is about 10 db greater. The sound energy is practically uniformly distributed round the Il-14, giving a total noise level of 100 db and 110 db at 100 m. and 30 m. respectively. The Tu-104 noise levels in the directions of the maxima are practically the same for engines operating at maximum and cruising ratings.

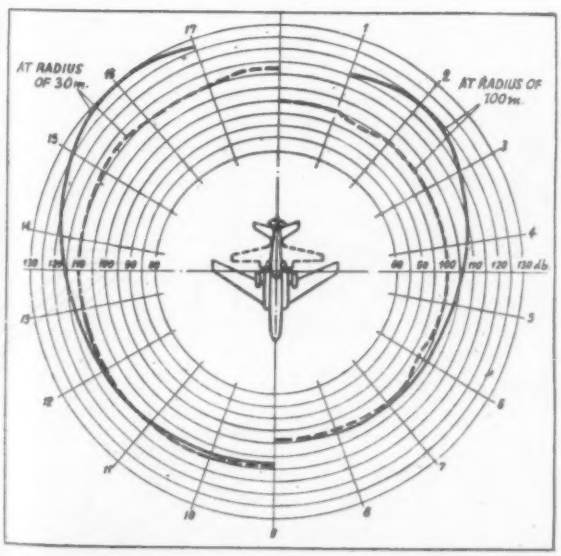


Fig. 1. Directional characteristics of total noise level of Tu-104 (continuous line) and Il-14 (dashed line). Engine-operating at continuous rating.

The intensity levels of noise created by aircraft flying over the listening point were determined in an open space at a point about 4,500 m. from the take-off start. The Tu-104 reached a height of 400 m. above the point for normal take-off and full flight weight. Heights of 200 m. and 600 m. were reached at points respectively 1,750 m. closer to and 2,750 m. farther from the take-off start. The take-off path, altitude, and time of passage above the listening point were fixed by a B-10 barograph with an arrangement for recording the time. Fig. 2 shows the take-off paths of the Tu-104 and the prototype French jet airliner, the Caravelle. This shows the points at which noise levels were measured: 2 for the Tu-104; A, B, C and E for the Caravelle. Points 1 and 3 are inserted conditionally, in relation to the altitude of the Tu-104 above point 2.

The noise levels of the Il-14 were measured during horizontal flight over the listening point since the take-off path is considerably shorter.

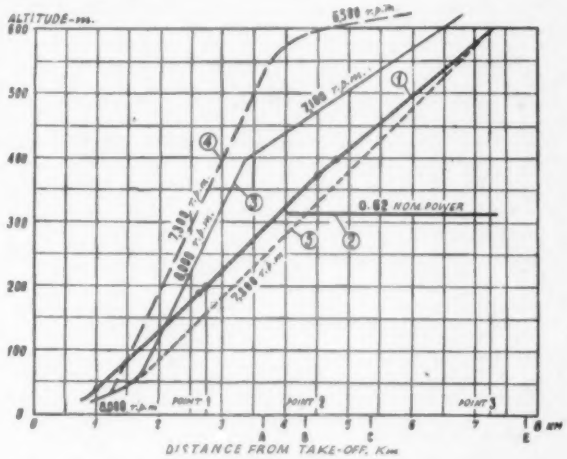


Fig. 2. Flight paths of Tu-104 and Caravelle during noise measurements on the ground. 1—normal take-off and climb path of Tu-104; 2—special take-off path of Tu-104 with transfer to horizontal flight at altitude of 310 m.; 3 and 4—special take-off and climb paths of Caravelle at maximum engine-operating regime and reduced take-off weight; 5—normal take-off and climb path of Caravelle.

The engines of the aircraft were operating at a cruising rating and the altitude corresponded to that at which the Tu-104 flew over the point.

Measurements were made of the total noise level and the level in the frequency range 300-600 c/s, being the most unpleasant frequency range for the ear. For flights at altitudes of 200 m. and 400 m. the noise levels in all octaves were recorded.

Data on the total noise levels of the Tu-104 and Il-14 are given in Table 1. This also shows figures, given in foreign technical publications, for the noise levels of the Caravelle, Stratocruiser, DC-4, DC-6, DC-7, Constellation and Super Constellation.

It follows from Fig. 2 and Table 1 that noise levels may be compared at the points 2 and B, 3 and E, and also 2 and A. Although point A was 850 m. closer to the take-off than point 2, the aircraft were at the same altitude there, and the total noise levels of the Tu-104 and the Caravelle were of the same order.

At points 2 and B, situated at the same distance, for normal flights of the Tu-104, Caravelle, and four-engined piston aircraft, the noise level of the Tu-104 is 4 db lower than that of the Caravelle (99 and 103) and 6 db lower than that of aircraft with four piston engines (99 and 105).

Point 3 was 550 m. closer to the take-off than E. Because

TABLE 1

Type of Aircraft	Altitude above point (m.)	Average value of total noise intensity (db)	Engine operating regime above point	Take-off regime	Distance from take-off start (m.)	Legend of point
Il-14	200	98	Continuous	—	—	—
	400	90	Continuous	—	—	—
Tu-104	375-400	99	Continuous	Normal	4,500	2
	600	98	Continuous	Normal	7,250	3
	310	93	0.62 Continuous	Special	4,500	2
Caravelle	430	100	7,100r.p.m.*	Special	3,650	A
	600	94	6,500r.p.m.*	Special	4,300	B
	290	103	7,300r.p.m.*	Normal	4,300	B
	530	94	7,100r.p.m.*	Special	5,350	C
	660	92	7,300r.p.m.*	Normal	7,800	E
4-engined (piston) aircraft	—	105	—	—	3,650	A
	—	105	—	—	4,300	B
	—	106	—	—	5,350	C
	—	95	—	—	7,800	E

* Up to 400 m., engine operating regime 8,000 r.p.m.

of this, the total noise levels of the Tu-104 are a little higher than those of the Caravelle and piston-engined aircraft.

Table 1 also gives the Caravelle noise levels for special take-offs (with longer use than usual of maximum operating regime of engines or with lower take-off weight). For such take-offs the noise is considerably less.

The Tu-104 can also make special take-offs. Thus, for a Tu-104 flying a horizontal stage with engines operating at 0.62 of the nominal regime, having attained an altitude of 300 m. in the normal way (see Fig. 2), the total noise level on the ground is 93 db. Consequently the total noise level of the Tu-104 on the ground below the take-off path at a distance of 3,800-4,200 m. from the take-off start can be reduced to that of the Il-14 if, after reaching an altitude of 250-300 m., the aircraft changes to horizontal flight (e.g., for flight above a populous centre) with engine regime 0.62 continuous rating.

In addition, the noise level was measured for several regular-service Tu-104s flying above the listening point (see Table 2).

TABLE 2

Recognition sign ..	L5412	Not recorded	L5436	L5427	L5439*
Total noise level db ..	93	90	94	96	100

* Full take-off weight; altitude over point 2 reported from on board 400 m.

Fig. 3 shows the noise spectra on the ground about 4,500 m. from the take-off point for the Tu-104, Caravelle, and four-engined piston aircraft (Super Constellation, DC-6, DC-7). The noise spectrum of the Tu-104 (altitude above listening point, 375 m.) is disposed between those of the Caravelle, approaching at conversational frequencies the noise spectrum of the latter flying at an altitude of 600 m. In this case, for a standard tone with frequency 1,000 c/s, the total noise level for the Tu-104 is 105 phons, for the Caravelle 109 phons on normal take-off and 101 phons on special take-off.

The noise spectra for take-off of the Tu-104 and four-engined piston aircraft, measured on the ground about 4,500 m. from the take-off point, are roughly the same in the range of octaves 4-6. At lower frequencies the Tu-104 noise level is 3-10 db lower, and in octaves 7-8, 4-7 db higher.

It should be noted that the Tu-104 noise spectrum shown in Fig. 3 was obtained for normal take-off and climb (beginning at an altitude of 35 m.) at full flight weight and continuous engine operating regime.

The following conclusions can be made from an analysis of the work done.

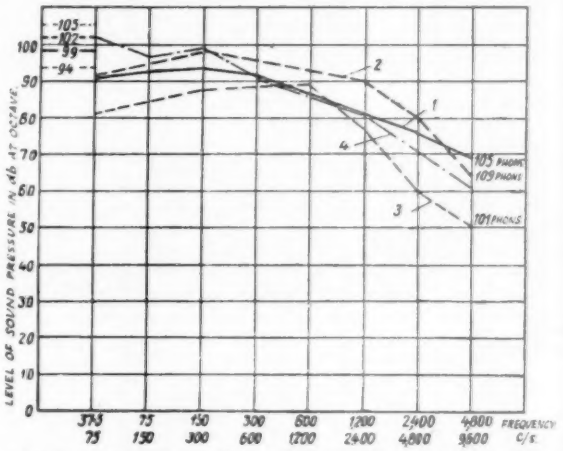


Fig. 3. Noise spectra of aircraft flying above listening point. 1—Tu-104 (L = 4.5 km., H = 375 m., Moscow, 2); 2—Caravelle (L = 4.3 km., H = 290 m., New York, B); 3—Caravelle (L = 4.3 km., H = 600 m., New York, B); 4—aircraft with four piston engines (L = 4.3 km., New York, B).

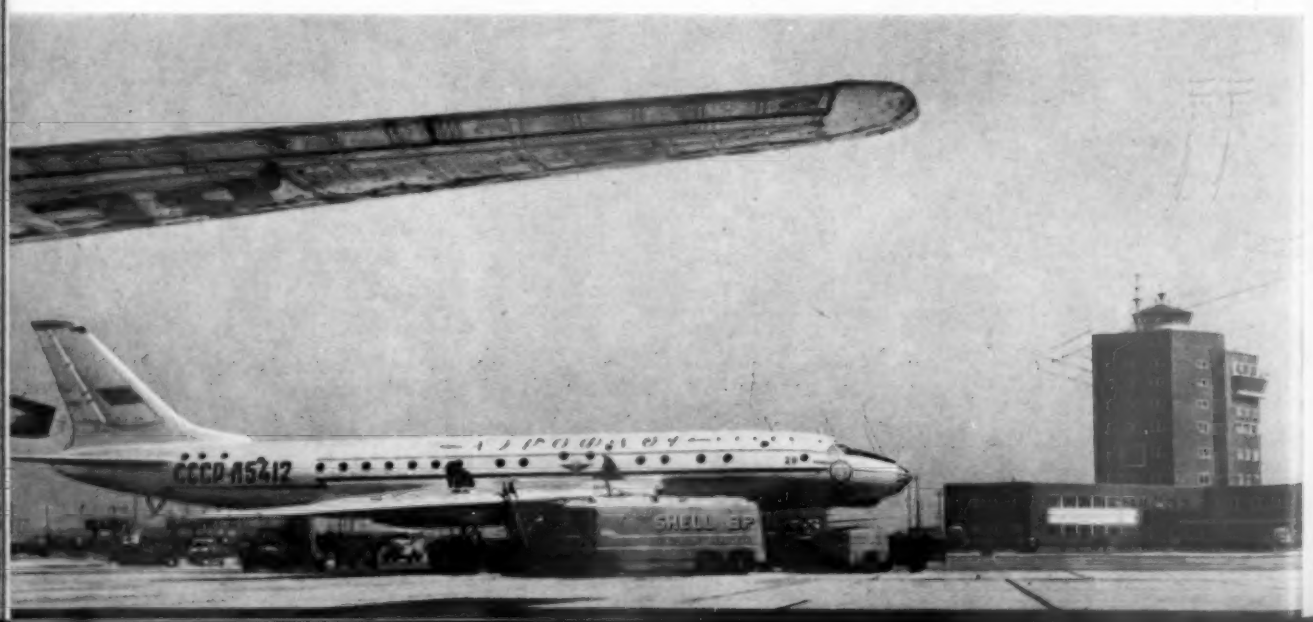
The Tu-104 at a height of 375 m. above a listening point situated 4,500 m. from the take-off start produces a noise level of the same order as that of an Il-14 at a height of 200 m.

The total noise level of the Tu-104 under the take-off path at a point on the ground 3,800-4,200 m. from the take-off start can be reduced to that of the Il-14 if, after reaching a height of 250-300 m., the aircraft changes to a horizontal path with engine-operating regime 0.62 of continuous.

The noise on the ground beneath the take-off path of a Tu-104 is of the same order as that of the Caravelle and foreign four-engined piston aircraft.

The level of noise created by aircraft taking off in regions lying close to airfields can be reduced by adjustment of take-off regimes.

A RUSSIAN IN ENGLAND.—The Tupolev Tu-104, L5412, which was used in the tests described in this article. It is here seen at London Airport when it flew in on a special service in 1956.

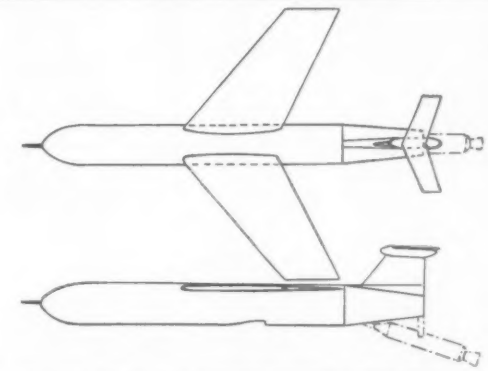


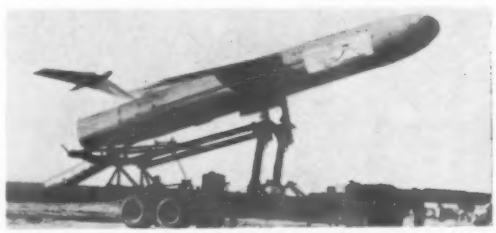
THE AEROPLANE

GUIDED WEAPONS DATA SHEETS

More of our copyright series of guided missile data sheets are given on this and the following page. Previous sets have appeared in THE AEROPLANE for December 6, 1957, January 3, February 14 and March 14 last, when it was explained that the contents of the tables are based on published data from a number of sources and arranged in a standardized form. In this present set, as in the case of the previous tabulations, there are inevitably some gaps as a result of security restrictions or unreliability of published data. Further sets of these sheets, which have been compiled by MR. D. HOWE, D.C.Ae., A.M.I.Mech.E., A.F.R.Ae.S., will be published in THE AEROPLANE, at regular intervals.

Throughout the tables the following abbreviations have been used:—A-A=air-to-air, A-S=air-to-surface, A-U=air-to-underwater, S-A=surface-to-air, S-S=surface-to-surface, S.R.=solid rocket, L.R.=liquid rocket, T.J.=turbojet, R.J.=ramjet.





MACE (T76)	S-S	U.S.A.
Design/Manufacture *Martin/Martin*		**Service** *U.S.A.F.*

Guidance :
Control : *Fin and Tailplane Trailing Edges.*
Warhead :

Main Power :
One T.J. (J33) (Allison). THRUST : *4,600 lb.* DURATION : sec.
FUEL : *Kerosene.* OXIDANT : —

Boost Power :
One Tandem S.R. THRUST : *lb. for* sec.

Weights :
MISSILE : *13,800 lb.* WEIGHT BOOSTED : *lb.* PAYLOAD : *lb.*

Dimensions :
LENGTH : *45.8 ft.* MAX. DIA. : *4.5 ft.* WING SPAN : *28.7 ft.*
FIN SPAN : *ft.*
BOOST LENGTH : *ft.* BOOST DIA. : *ft.* BOOST SPAN : *ft.*

Performance :
SPEED : *M=0.9.* HEIGHT : *45,000 ft.* RANGE :

REMARKS :
Was TM 61B.
Initial Production.
For TM 61A see *The Aeroplane*, January 3.

REGULUS I (SSM-N-8a)	S-S	U.S.A.
Design/Manufacture *Chance Vought/Chance Vought*		**Service** *U.S. Navy*

Guidance: *Radio Command (wire for launch).*
Control: *Wing Trailing Edge.*
Warhead: *Nuclear.*

Main Power:
One T.J. (J33) (Allison). THRUST: *4,600 lb.* DURATION: sec.
FUEL: *Kerosene.* OXIDANT: —

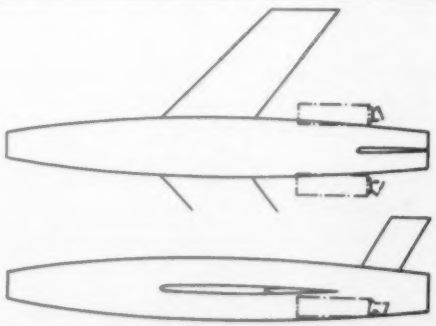
Boost Power:
Two S.R. THRUST: *60,000 lb. for 3 sec.*

Weights:
MISSILE: *12,500 lb.* WEIGHT BOOSTED: *14,600 lb.* PAYLOAD: *lb.*

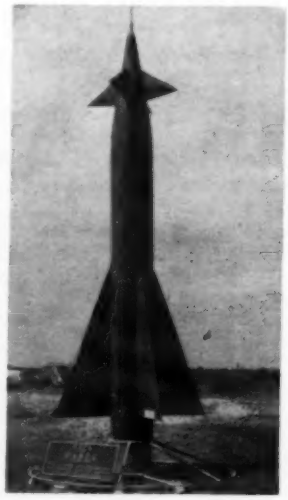
Dimensions:
LENGTH: *32.0 ft.* MAX. DIA.: *4.5 ft.* WING SPAN: *21.0 ft.*
FIN SPAN: — *ft.*
BOOST LENGTH: *7.0 ft.* BOOST DIA.: *2.0 ft.* BOOST SPAN: — *ft.*

Performance:
SPEED: *M=0.9.* HEIGHT: *ft.* RANGE: *200 miles.*

REMARKS:
Fin and wings fold. Can be launched from submarines.
Operational.
For Regulus 2 see *The Aeroplane*, December 6, 1957.



THE AEROPLANE
GUIDED WEAPONS DATA SHEETS



PARCA — S-A — FRANCE

Design/Manufacture D.E.F.A./D.E.F.A. | **Service**

Guidance: *Command Link.*
Control:
Warhead:

Main Power:
One L.R. THRUST: lb. DURATION: sec.
FUEL: OXIDANT:

Boost Power:
Four Wrap-round S.R. THRUST: lb. for sec.

Weights:
MISSILE: *2,200 lb.* WEIGHT BOOSTED: lb. PAYLOAD: lb.

Dimensions:
LENGTH: *16.7 ft.* MAX. DIA.: *1.6 ft.* WING SPAN: *5.3 ft.*
FIN SPAN: *3.4 ft.*
BOOST LENGTH: *10.0 ft.* BOOST DIA.: *0.6 ft.* BOOST SPAN: *5.8 ft.*

Performance:
SPEED: *M=1.7.* HEIGHT: *82,000 ft.* RANGE:

REMARKS:

THOR (WS-315A SM75) — S-S — U.S.A.

Design/Manufacture *Douglas, General Electric*/Douglas, General Electric** | **Service** *U.S.A.F. R.A.F.*

Guidance: *Inertial (A.C. Electric).*
Control: *Tilting Rocket Motor.*
Warhead: *Nuclear.*

Main Power:
One L.R. (N.A.A.) THRUST: *165,000 lb.* DURATION: sec.
FUEL: *Alcohol.* OXIDANT: *Liquid Oxygen.*

Boost Power:
None. THRUST: — *lb. for* — *sec.*

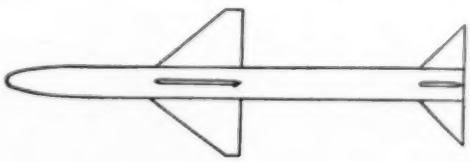
Weights:
MISSILE: *100,000 lb.†* WEIGHT BOOSTED — *lb.* PAYLOAD: lb.

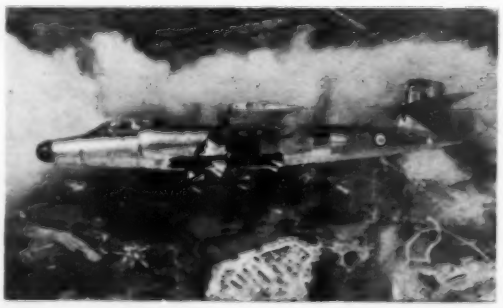
Dimensions:
LENGTH: *63.0 ft.‡* MAX. DIA.: *8.0 ft.‡* WING SPAN: — *ft.*
FIN SPAN: *12.0 ft.‡*
BOOST LENGTH: — *ft.* BOOST DIA.: — *ft.* BOOST SPAN: — *ft.*

Performance:
SPEED: HEIGHT: *ft.* RANGE: *1,500 miles.*

REMARKS:
Thor uses many Atlas parts.

* Nose cone (end stage). † Approx. ‡ Estimated.





SPARROW 2 & 3 (AAM-N-3 & 4) — A-A — U.S.A.

Design/manufacture *Douglas (2) Raytheon (3)/Douglas Raytheon* | **Service** *U.S. Navy, R.C.A.F.*

Guidance: *Homing (Raytheon—Sparrow 3).*
Control: *Moving Wings.*
Warhead:

Main Power:
One S.R. THRUST: lb. DURATION: sec.
FUEL: OXIDANT:

Boost Power:
None. THRUST: — *lb. for* — *sec.*

Weights:
MISSILE: *350 lb.* WEIGHT BOOSTED: — *lb.* PAYLOAD: lb.

Dimensions:
LENGTH: *11.0 ft.* MAX. DIA.: *0.67 ft.* WING SPAN: *3.33 ft.*
FIN SPAN: *2.8 ft.*
BOOST LENGTH: — *ft.* BOOST DIA.: — *ft.* BOOST SPAN: — *ft.*

Performance:
SPEED: *M=2.8.* HEIGHT: *ft.* RANGE:

REMARKS:
Initial production.
To be produced also in Canada for Avro Arrow.

BOOK REVIEWS

AFTER THE MONSOON. By Oliver Moxon. 160 pp.; 5¼ in. by 8¼ in. Robert Hale, Ltd. Price 15s.

THIS is part of a story of the Burma war from the pen of a member of "Mandrake Squadron," which was engaged in a fight for survival in the forgotten Imphal Valley campaign of 1944. The book is the final volume of a trilogy by an author who certainly knows how to write, and who does not refrain from portraying the seamy side of his own emotions in both duty and pleasure.

As he says in a brief foreword, he has tried to mirror "a truthful image of a young man's moral decline at the hand of war"!

Taking up the story of Mandrake Squadron as recounted in "The Last Monsoon," he describes the scene when the squadron arrived at Pathakandi, 200 miles behind the front line, in the "dust-caked hulks of machines which had once been Hurricanes," and were met with a certain lack of appreciation of their recent efforts—37 sorties in two weeks without a night's sleep.

After a variety of operations consisting mainly of low-flying patrols, and one sombre affair featuring a massacre of elephants, the author had the misfortune to crash his Hurricane at a place called Wangjing, either as a result of over-tiredness or carbon-monoxide, and that ended his flying career with S.E.A.C., but it certainly did not end his adventures.

Well, there is no doubt that the tedium of things like transit camps, of which Whorli appears to have been a good example, is apt to get under the skin of chaps who have been up and doing, and the author's impudent initiative in the local bazaar was a glorious episode which must have given him a lot of satisfaction. As he puts it, "opportunism coupled with brutal fearlessness produces a fortune," sometimes.

A further spell in a transit camp in Egypt nearly finished his career, but eventually he arrived in London about the time that the V-2 rockets were falling.

There is not much to his liking there and if it were not for his faculty for finding the humour in disillusionment and banality there would not be much to anybody else's liking either.

Eventually his discharge papers came through and "this grotesque twilight of Service life was closed." "I was filled," he says, "with a bizarre fascination at the simplicity with which a person could be cast adrift from this machine after risking his life plenty of times in its service."

He certainly does not seem to have had much luck in the one or two jobs offered him and one is left wondering what has happened to a man who, having served his country in the hour of need, is obviously out of tune with the aftermath.

It would be a pity if his literary ability is confined to this trilogy. We shall look for more.—R.C.P.

AIRCRAFT MECHANIC'S POCKET MANUAL (Fifth Edition). By Joseph A. Ashkouti. 188 pp.; 5 in. by 8 in. Sir Isaac Pitman and Sons, Ltd. Price 20s.

THIS BOOK is of little use to anyone on this side of the Atlantic as it deals largely with American terminology, specifications, standards, colour coding, practice and materials, and does not cover the British or Continental equivalents.

Use of such terms as "scratch-awl" instead of scriber and "metallizing" instead of metal-spraying are apt to be confusing, and one feels that the manual should be translated into English besides including European information.

Even for the American reader the book is of limited value, and much of the information is completely out of date. Thus there is no Navy designation "E" for Edo, "K" for Kaiser Cargo or "N" for the Naval Aircraft Factory. "Y" for some years has stood for Convair, not its predecessor Consolidated-Vultee, and "O" no longer is a Lockheed letter.

The gravest deficiency is in the Aircraft Nomenclature, which refers only to piston-engined aircraft and has a Grumman Wildcat as a typical specimen. There is thus no explanation of any gas-turbine terms. It is puzzling to read the totally inaccurate statement that "angle of incidence," the wing-setting angle, is equivalent to the "American" term "angle of attack" in "British" terminology. In fact, the so-called "American" terminology is the accepted form, although the two terms are sometimes loosely interchanged.

While such terms as "stabilizer," "airplane" and the like are easily understood Americana, it is a little odd to read that an axial-type engine transmits power to the shaft "through a wabble plate, swash plate or gears."—D.G.

FAMOUS AIRLINERS—1, THE VISCOUNT, and 2, THE BRITANNIA. By Derek Harvey. Approx. 110 pp. each; 7½ in. by 5 in. Cassell and Co., Ltd. Price 10s. 6d. each.

IT IS indicative of the growing public interest in transport aeroplanes that a publisher has embarked on a series of volumes, each of which is devoted to a single type of aircraft. Hitherto it has been left, in general, to the manufacturers to tell the story of their own aircraft in such detail as this.

Derek Harvey has set out to produce, in these volumes, readable accounts of the history and development of the Viscount and Britannia, and also describes their structure, accessories, powerplant, performance and flying characteristics. The books are intended for the general reader rather than the expert and, having been prepared with the collaboration of the makers, are factually correct. The author's style is easy to read, and there are plenty of illustrations to help sustain the reader's interest.

Our major criticism of the book is the price, which even by today's standards seems ridiculous for a small and slender volume. The layout would also have been improved by using a smaller number of larger pages.—F.G.S.

CAREERS ENCYCLOPEDIA. By G. H. Chaffe and P. J. Edmonds. 672 pp.; 5¼ in. by 8¼ in. Cleaver-Hume Press, Ltd. Price 15s.

ONE OF the most frustrating things for the employer interviewing young people leaving schools and universities is to find how vague many of them are about what they want to do and how they would set about it. It is easy to blame careers masters, university appointments officers and youth employment officers for not doing their job. The "Careers Encyclopedia" shows just how big their problem is and at the same time helps to reduce it to more manageable proportions.

It deals in alphabetical order with a very wide range of careers from accountancy to youth leadership devoting a substantial section to each. The nature of the work is described in each case with such things as the prospects, age of entry, educational requirements, essential qualities, further education and training involved, colleges where studies can be pursued, examinations to be taken, addresses of relevant professional bodies and bibliography of other books of reference on the career chosen.

The book is remarkably comprehensive. The reader will find for example under "A" such diverse occupations as accountancy and atomic energy, architecture and auctioneering, archaeology and agriculture and, of course, aeronautical engineering, and all of them are dealt with in the same authoritative detail.

A number of general articles help to direct people with only vague ideas of a career towards the specific openings likely to interest them, and several appendices deal with important matters like deferment and university entrance requirements.

It is possible to criticize minor points. The book has not, for example, quite kept up with the development of undergraduate apprenticeship schemes in the major aircraft companies, and I could find no mention of the very many scholarships which large employers make available both to schoolboys and to apprentices to enable them to take university degrees and diplomas in technology. But each section is so fully documented that the serious inquirer following through the references given would automatically fill in such occasional gaps and secure a sound appraisal of any career he investigates.

There should be copies of the "Encyclopedia" on the bookshelves of every school or university careers library, in every public library and in the office of every youth employment officer. Parents and teachers armed with it will be able to advise young people with real authority, and no youth need let himself be pitchforked into a job until he has browsed through it and knows what he is about.

When all this happens the book will be serving a very worthwhile purpose.—E.C.B.

NEWS OF INDUSTRY

Heat Resisting Laminate

A NEW material under the trade name of Astrolite has been announced by The British Refrasil Co., Ltd. This is a laminate incorporating a high-temperature resin and Refrasil materials, which will, for short periods, withstand temperatures in the order of 5,000° F., and should prove of interest to those concerned with thermal problems in connection with missiles and rockets.

One test made on a ¼-in.-thick Astrolite laminate is stated to have resisted for 142 sec. a flame temperature of 4,600° F. before finally burning through, as compared with a similar thickness of stainless steel which lasted only 82 sec.

If Astrolite is exposed to extremely high temperatures a layer of the plastic on the exterior burns off, leaving a surface of Refrasil (silica fibres) so arranged that they will not easily be removed by the gas stream. At about 3,000° F. the fibres begin to soften, but since melted silica is a sticky, viscous substance, it remains in position until evaporated. The action of vaporization draws heat from the remainder of the laminate, and assists in cooling.

New Glass-cloth Fabric

A NEW fabric known as Plastoglass has been introduced by Storey Brothers and Co., Ltd., of White Cross, Lancaster. It is a glass-fabric reinforced vinyl film which in different grades weighs between 11.5 and 23 oz. sq. yd. Cost of the lighter grades is 10-12s. per yd. for 50-in. widths.

Advantages claimed for Plastoglass are high tensile strength and dimensional stability, resistance to fire, mildew and rotting, and low cost. The fabric is said to be waterproof and unaffected by sunlight and exposure. It can be produced with a variety of surface finishes and brightly coloured printed patterns. Welding can be used for the seams of products made from the material.

Main applications for the material are expected to be outdoors where it can be used for blinds, canopies, covers, and many other applications. Its high strength suits it for use in the construction of inflatable dinghies, lifebelts and marker buoys.

Air-travel suitcases are among the many things which can be made from Plastoglass, a new type of fabric referred to below.

The first large commercial application of Plastoglass has been on air-travel suitcases produced by the Revelation Suit Case Co., Ltd. These suitcases are light, strong and attractive in appearance. They have been tested in B.O.A.C. service; a test batch stood up well to ordinary baggage-handling treatment when flown over B.O.A.C. routes totalling 21,708 miles.

Bellows Assemblies

WITH the increasing demand for higher standards of accuracy, reliable performance, and closer tolerances in the design and construction of bellows for instrument and control systems, Avica Equipment, Ltd., of Hemel Hempstead, is now offering a complete series of high-precision seamless bellows and bellows assemblies for such applications. These units are produced to high standards of finish and tolerance using materials which are closely controlled throughout all manufacturing stages to ensure uniformity of grain structure and wall thickness.

The tooling used in the production of the initial tube and the finished bellows is designed to eliminate any factors which may contribute towards inconsistencies either in performance or dimensions. The bellows are normally supplied in the cold-worked condition, but additional heat-treatment operations such as stress relieving or annealing may be undertaken if required. Micro-hardness checks may be included as part of the high standard of quality control maintained.

Precision bellows can be produced in any of the conventional materials used for instrument and control systems, and at the present time are available over a bore size range from 3.8 in. to 12 in. The ends can be terminated in a number of ways to suit the installation and attachment of other components. The corrugations may be finished off flush, or may have tubular cuffs, the diameter and length of which may be varied infinitely.

As a result of extensive experience in the design and construction of complete high-performance bellows assemblies over the past 10 years, Avica can supply complete tested assemblies for direct fitment to the users' equipment as well as individual bellows. In the case of complete assemblies, the method adopted for mating the bellows to the end components may vary, as also may the medium used to form the hermetic seal.

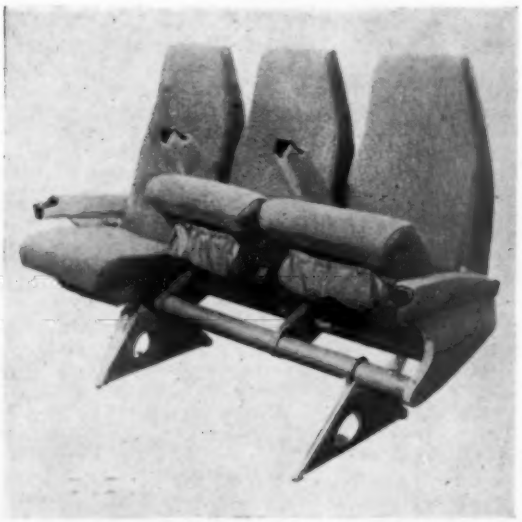
Comfort for Economy Passengers

WHEN Aircraft Furnishing, Ltd., was formed, in November, 1956, to co-ordinate the work of three companies in the airline passenger-seat market, the decision was made to concentrate in the likely requirements for super-high-density, long-haul air travel. When, therefore, the economy-class interior configurations were being finalized towards the end of 1957, and were introduced this year, something new in the way of comfortable, lightweight chairs was already available.

The range of chairs offered by Aircraft Furnishing has two features which are especially important to the comfort and convenience of travellers on economy-class and tourist services. The furnishings of the aircraft cabin, used on economy services, must necessarily involve three-abreast seating and seat-pitching of as little as 33-34 in.

The new features which help to make this configuration more acceptable are a very high "shin clearance" of 14-15 in. below the back of each seat—so that passengers can stretch out their legs—and the use of tip-up seats so that passengers can reach the aisle more easily.

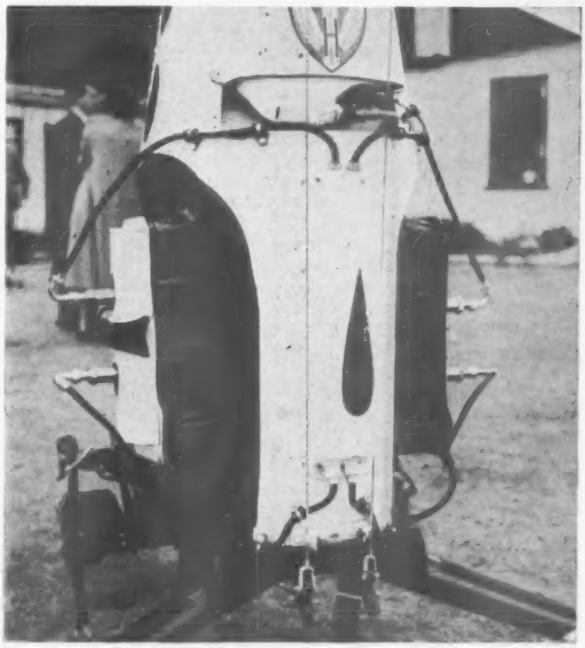
Contracts of considerable size for these new chairs have been placed by the two airline Corporations, which have, incidentally, co-operated in their development for use in B.O.A.C.'s Britannia 312s and DC-7Cs, and in B.E.A.'s Viscount 701s (60-seat version) and Comet 4Bs. The seats for B.E.A. will be in production later this year and include further features such as hinging and folding legs to permit them to be stowed against the cabin wall. These seats will be stressed for 9 *g* in forward- and aft-facing conditions.

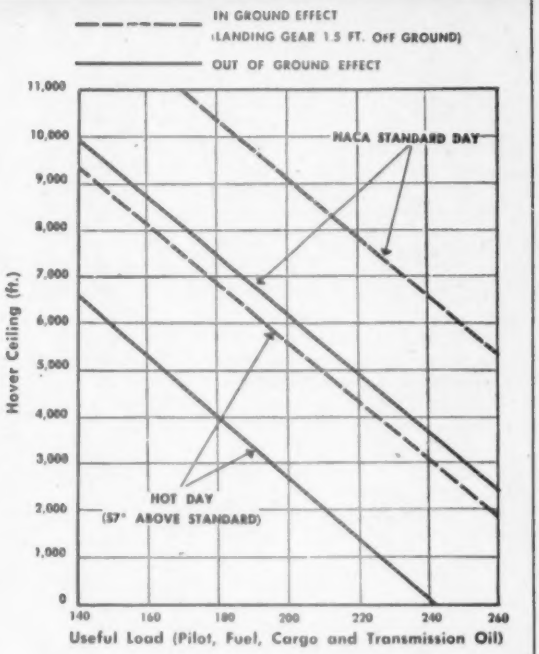


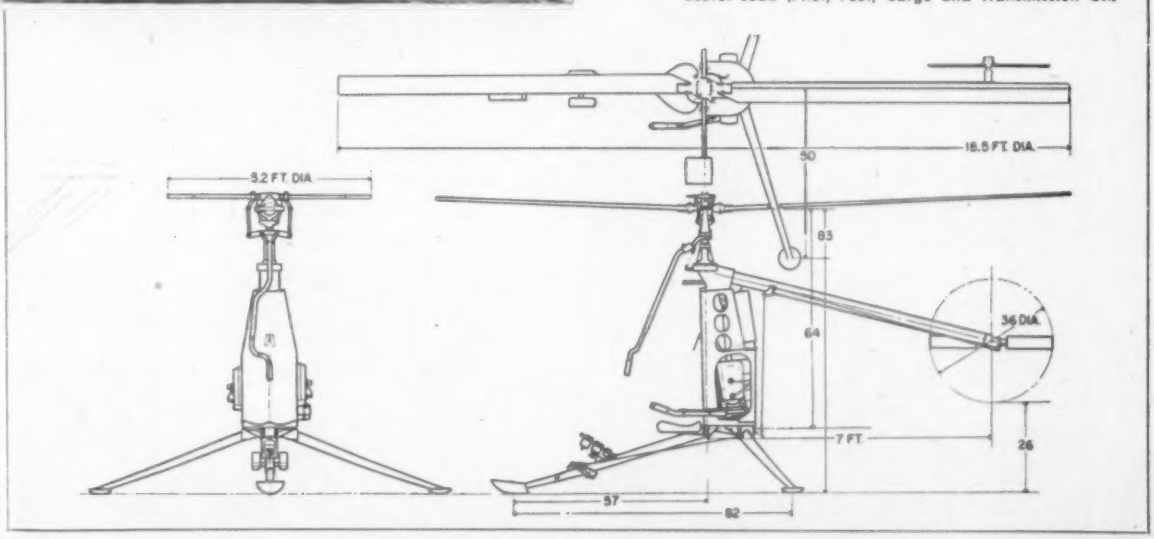
The triple tourist/economy chair which Aircraft Furnishing, Ltd., is currently producing for B.O.A.C. Features are tip-up seats and high "shin clearance" when the chairs are closely pitched.

Solo Helicopter

More views and figures for Hiller's diminutive Rotorcycle recently demonstrated in London (THE AEROPLANE, *May* 16). *Note the neat installation of its* 45-*h.p. Nelson two-stroke.*







Automatic Flight—The British Story

IN the 46th Wilbur Wright Memorial Lecture, Dr. G. W. H. Gardner, C.B., C.B.E., D.Sc., F.R.Ae.S., reviewed the history of automatic flight from Sir Hiram Maxim's proposal in 1891 for automatically stabilizing his proposed aeroplane by gyro-controlled elevators, to the latest work of the Blind Landing Experimental Unit.

The basis of the modern system was laid by the development of an automatic pilot by G. L. Smith and P. S. Kerr for the rudder control of an experimental pilotless aircraft. This drone had been developed successfully by February, 1925, when it made a flight of 39 minutes and responded to 43 radio signals.

From this experimental achievement, work on a weapon, the Larynx, was begun in 1925 on the basic concept which the V.1 was later to employ. A single gyro was used to control the elevator and the rudder, and there was no lateral control. Successful trials were made in the Bristol Channel in 1927, and again trials with limited success in Iraq in the summer of 1928, though there was engine trouble thought to be caused by the heat. These latter trials were conducted by R.A.F. personnel, eight in all, and within three years of the beginning of the project, but they were not followed up for the weapon was not adopted by the R.A.F.

The "bomb versus battleship" controversy prompted the development of a target drone to be called the Fairey Queen for trials of the effectiveness of fleet anti-aircraft fire, as the successful bombing trials of the "Centurion" could not include that factor. The Fairey Queen project was completed in two years and after development with a safety pilot (who could be carried, as the drone was developed from the Fairey III D), two unsuccessful pilotless flights were made.

The third and last drone was given a short but successful flight test and was taken to Gibraltar for a fleet firing trial. It flew as a target for two hours of gunnery practice and then made a successful landing.

This showed the value and need of a target drone, and the de Havilland Moth was made into a useful and cheap drone with a simplified control system.

Within a year of undertaking this project a trial of the Queen Bee was witnessed from the bridge of H.M.S. "Orion" by a number of distinguished officers. The trial went well for a time, and then the Queen Bee, which was in a slow turn at low altitude, failed to respond to signals and soon was seen to be making for the bridge. While the controlling officer continued to go through the motions of control, but vainly, there was a general move to take cover, but the Chief of the Air Staff stood his ground and slowly turned up his collar, then the Queen Bee passed and hit the sea.

Four hundred and twenty Queen Bees were built and some of them made as many as 20 flights as targets.

Dr. Gardner reviewed the design and behaviour of auto pilots in guided weapons, and those for supersonic aircraft, and then turned to the problem of blind landing. After the War, F. W. Meredith developed the Mark IX autopilot using rate gyros. This could be used in an automatic landing system and the Blind Landing Experimental Unit was working on a method in which the auto pilot was governed by data from the ILS during the approach and was then switched to data from a leader cable and a radio altimeter to make the landing. The system, protected by safety features and confidence checks, had been used for 1,600 landings either partly or wholly under automatic control without damage to an aircraft. It is accurate in its working, the lateral error of touch-down on the runway being 6 ft.

The understanding of the problem of stability needed for the design of all these controls was based on the work of Bryan and Williams, which was extended to the controlled aircraft by Gates and Case; the contribution of Meredith in advancing the art had been outstanding among many who had played their parts.

There was now greater scope for aeronautical research than ever before. There were the possibilities of nuclear propulsion, giving virtually unlimited flight endurance at low heights, of manned satellites, and of unmanned bodies escaping from the gravitational field of the Earth to explore outer space.

Though Dr. Gardner did not tell us of any contribution he had made, the projects he has worked on have gone forward, often with remarkable speed, so it may be necessary to read a little between the lines of his paper.—"KENTIGERN."

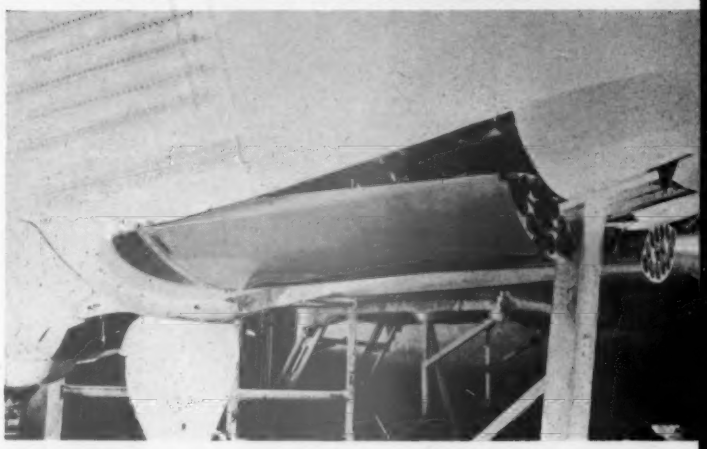
R.Ae.S. Award Winners

Presentations were made on the occasion of the Wilbur Wright lecture

Above (l. to r.) Dr. P. B. Walker (R.Ae.S. Silver Medal), Dr. D. Williams (R.Ae.S. Bronze Medal), Mr. S. D. Davies (British Gold Medal for Aeronautics). Left: Mr. W. H. Lindsey and Mr. W. F. Saxton (jointly awarded the British Silver Medal for Aeronautics).

Above (l. to r.): Sir Richard Southwell (Honorary Fellowship), Mr. W. E. Nixon (Honorary Companionship), Sir Sydney Camm (R.Ae.S. Gold Medal). Below (l. to r.): Mr. W. Tye (Wakefield Gold Medal), Mrs. Anne Burns (R. P. Alston Medal), Mr. P. A. Champion (N. E. Rowe Medal).

NEW FREIGHTER. (Above) the major fuselage assembly of the Armstrong Whitworth A.W.650 gives a clear indication of the size of this interesting new commercial project. NEW ARMAMENT. (Right) for the D.H. Sea Vixen is a pair of internal batteries each mounting 14 2-in. air-to-air rockets. For firing, the batteries extend into the slipstream and retract immediately after the rockets are fired.



NEWS IN PICTURES

NEW FROM ITALY. 6/8-seat executive aircraft is the Piaggio P.166, seen (left) at Villanova d'Albenga airport. It is not, like the P.136 from which it is evidently developed, an amphibian. The engines are Lycoming GSO-480-B1C6s. SEASON'S FIRST. Pictures below were taken at the Channel Islands international air rally of May 9-11, which is briefly described on page 730.

PRIVATE FLYING

H.J.C.'s Club Commentary:

● THIRTY - EIGHT aeroplanes attended the fourth international air rally organized by the **Channel Islands Aero Club** (Jersey) over the week-end of May 9-11. Several competitions were held, the winners decided on a points basis, and the rally began with an arrival competition between 14.15 and 14.45 hrs. on the Friday.

Participants who took the long sea crossing direct from the United Kingdom had the benefit of a two-Anson escort organized by the R.A.F. and the Hampshire Aeroplane Club, and air/sea rescue helicopters were on call. Fortunately, there was no need for their services.

Following a round of entertainments which included a banquet, dinner and dance, a tour of Jersey and local flying, guests left for home at mid-day on the Sunday. (Pictures p. 729.)

● PRIZES, presented by Senator W. H. Krichefski, president of the touring committee, during the banquet at the Portelet Hotel, were won as follow:—

Quennevais Trophy for most points, H. B. Showell, Aiglet, G-AOFS; Concours d'Elegance, F. Emery, Gemini, G-AKEI; time of arrival, M. Lalanne (Aéro-Club Normandie), and the lucky-landing prize, P. Ryder, Messenger, G-ALAP.

A Proctor 4, G-ANYZ, was the prize in a raffle—tickets cost £5 each—and it was won by a member of the Surrey Flying Club, who was unfortunately not present at the rally.

● ON April 25 **No. 604 Squadron Flying Group** held a cocktail party at the R.A.F. Club "to keep up morale" while its Proctor 3 was grounded for C. of A. renewal. Having started operations on June 1 last year, with the generous assistance of the Kemsley Flying Trust, three months after the disbandment of the Auxiliary Squadrons, the club achieved 170 hr. in the succeeding 10 months.

Much of this flying has been done on the Continent, and Milan, St. Moritz, Cannes and Biarritz have been visited. But it seems inevitable that the impending closure of Croydon, and the loss of its night-flying and Customs facilities, will have an unfortunate effect on the group's activities.

● IN April the **Exeter Aero Club** flew a total of 330 hr. With cadets, commercial pilot and P.P.L. students under tuition, the instructional staff—Joe Heelas and Mrs. Yvonne Pope—is kept very busy. Cdts. Davies and Price flew solo during the month.

Plans are going ahead for the club's annual display on June 28. There is to be extensive participation by R.A.F., R.N. and U.S.A.F. aircraft, and members of the parachute section of the Plymouth Aero Club will make formation and delayed drops from Tiger Moths. The show is to be opened by Sir Frank Whittle.

Club members have challenged the Plymouth club to a spot-landing competition at Exeter on July 12.

GLIDING NOTES

IN SPITE OF assertions that sailplanes are not designed as a reliable means of tran port "from A to B," they have often managed to serve that function in a downwind direction for many years past. But nowadays, with these laminar-flow wings, they just wander about the country at will. At Dunstable on Sunday afternoon, May 11, Nicholas Goodhart arrived in his Skylark 3 from a downwind direction, had another launch, and disappeared upwind into the distance.

Goodhart's "A to B" was actually Lasham to Newcastle, but on reaching Cambridge he decided that "B" was out of reach, and he would therefore return to "A" against the wind, which was blowing about 25 knots from W.S.W. at 2,000 ft. But, as his retrieving crew was well on the way to Newcastle, he landed at Dunstable to stop them by phone from going any farther, and because of this delay he had to come down finally at High Wycombe instead of Lasham. Total distance, 177 miles, of which 90 were against the wind.

There was quite a massive departure from Lasham northwards that day. Two pilots, John Holder with a Skylark 2 and Paul Minton with a Skylark 3, each made a 300-km. goal flight to Great Yarmouth on the east coast, gaining the Gold C distance qualification plus a Diamond. As the straight-line distance is only 152 miles, they had to steer a crooked course; Holder's first leg was N. by E. to Kettering, and Minton's N.N.W. to Edgehill at 90° to the wind, he having a better machine. Both took the same time, 5¼ hr., landing about 16.15 hrs., Brenda Horsfield writes; this is remarkably early, for it means a departure at 09.30 hrs. G.M.T.

Others flew north, some of them trying to make 300-km. goals in Yorkshire. Philip Wills went farthest, 135 miles to Sutton-on-Trent in the Standard Class Skylark 2; the others, in order of distance, were: David Hooper to Newark in Skylark 2, Wally Kahn to R.A.F. Wittering in T-42, Rika Harwood beyond Leicester in Skylark 2, and Malcolm Laurie in T-42 to Nuneaton, where bad weather stopped him. Farthest upwind was Dennis Burns, who took his Skylark 3 to Little Rissington, 60 miles N.W. by N. And John Stanley just managed Silver C distance to Biggin Hill before a two years' posting overseas by the Navy.

* * *

IT IS as well to slip up occasionally, as only thus can one discover the extent of the readership of "Gliding Notes." Remarking on the German decision to hold next year's national contests in the spring, instead of the summer, I hinted at the obtuseness of European countries in persistently fixing their contests in July or August when it had become obvious that the best cross-country soaring weather in this part of the World usually comes in April and May.

As a result, Mr. C. W. A. Oyens, Commodore of the Royal Netherlands Air Force and President of the Gliding Section of his country's Aero Club, has written to point out that they held last year's national contest there from May 26 to June 9, and will hold this year's from May 17 to June 1, "not because—quoting you—somebody woke up to the obvious, but after a thorough study by our Dr. Lucassen of the meteorological conditions in our country throughout the year." Last year's decision was justified, as they had nine contest days, as against only four the previous year.

Further, the Swiss *Aero Revue* for April, 1958, also commenting on "Gliding Notes," claims priority for having first recommended a change from summer to spring in its issue of August, 1955. Here it recalled that 60% of all Swiss post-War gliding records for distance, goal flight or goal-and-return were made in April, May or June. So why, it asks, are national contests never held in the spring?

* * *

IT is a rare event today for club members to build their own gliders, but Vic Ginn, of the London Club, has done so—at least, he has finished making the wings of a two-seater of his own design at Luton Airport, and is now having the fuselage made in the club workshop. It has a span of 60 ft., with the wings swept forward to let the rear pilot see past the wing roots; the chord is pretty generous: 6 ft. at the root, 28 in. at the tip. The wing has a twist of 5° which, Ginn says, disappears under load, and the wing structure is designed to make it do so; but there seems to be a possibility of it twisting the opposite way at really high speed. This is the first I have heard of a sailplane wing being deliberately designed to untwist at speed, though no doubt Mr. A. R. Weyl can rake up a case from the early years of this century.

* * *

SAILPLANE pilots who use the famous Bishop Wave, set up by the Sierra Nevada Mountains in California, owe very much to Robert Symons, who has unfortunately lost his life in a flying accident. He was permanently installed there as organizer of a mountain rescue service, and his expert advice on the wave was at everyone's service, as well as the loan of a sailplane if needed. Once, returning from a cloud-seeding expedition in a P-38, he found the valley so full of dust that it was impossible to land. But the wave was working, and he continued soaring in it between 12,000 and 30,000 ft., after his petrol had given out, until the dust had cleared. His 8-ton machine, with feathered airscrews, climbed at 3,000 ft./min.—A. E. SLATER.

CORRESPONDENCE

Bringing Back the Human Touch

THE leading article in THE AEROPLANE of May 9, "A Lightplane Revival?" re-started me thinking. So did the report in the same issue on the Hanover Show (p. 652). As I see it there are only two new means of locomotion left to the human race until we can defeat gravitation somehow. The one is Space Travel . . . about which we hear far too much . . . and the other is flying by muscular power—about which we hear far too little.

Both were, till recently, considered impossible. But space travel is evidently just round the corner, if not "round the bend," and it may well be that man-powered flight is no farther off. Indeed, the Russians claim they can do it and in this post-Sputnik age who are we to laugh that one off? November 1, 1955, Mr. Shenstone gave it as his opinion that the thing was possible and the designer of the Schwan I ornithopter glider shown at the Hanover Show evidently thinks so too. It is no good shutting one's eyes to the fact that aviation as now understood is too technical, too expensive and far too specialized to hold the interest (and certainly not the affections) of the ordinary citizen.

But could we manage, literally, to bring the "human" touch into some of it, what a change there might be.

I do not, of course, foresee flight made with muscle power supplanting powered aircraft nor, in its earlier stages at least, is it likely greatly to influence the art of sailplane flying. But no one will deny that technically its achievement will need much original thought and many more methods will have to be thought up if the correct method is to be discovered for coaxing around large volumes of air gently and smoothly enough to propel and sustain a man-powered aircraft. And it is a problem which the small group of enthusiasts with the right qualities can get their teeth into with at least some hope of success.

At the moment the incentives are lacking. These are, I feel, the starting of informed and intelligent articles, lectures and correspondence on the subject and, secondly, some chance of winning cash or fame or both.

Is it too much to hope that history might repeat itself and that large newspapers or industrial firms might see their way, soon, to offering worthwhile prizes for man-powered flight analogous to those put up in the first decade of this century? These original prizes (such as that for flights of the first circular mile or kilometre) were offered when the winning of them seemed *highly* improbable, if not quite impossible, but they started people talking, they encouraged those who were *doing* things and ofttimes they put the winner of them on to the road to fame and fortune.

That they indirectly did the promoters quite a bit of good is highly probable, too!

What an opportunity, in these dull days of guided missiles, to recapture some of the fun and enthusiasm which somehow got mislaid so soon after the start of it all. In his memoirs Lord Brabazon says, speaking of the pioneers, "it was not their fault, believe me it was not their fault, that it has all gone wrong."

It would be rather nice, don't you think, to try to put at least a little of it back into a form we could still *understand?*

Ipswich. H. J. PARHAM.

What Prospects?

HOW about naming the English Electric P.1 the Penultimate One?

Bexhill-on-Sea. HUGH A. GORDON.

Poland's Gift to Russia

I READ with interest the report in THE AEROPLANE for May 9 (p. 642) that eight Polish gliders had been delivered to the Soviet Union on April 15 of this year.

The delivery of the "Bocian" is described in *Sovetskaya Aviatsiya* No. 89/1958, which gives the date, however, as April 14. It has been named "Comradeship," and bears the Polish word "Przyjazn." This is "Druzhba" in Russian, and a bi-lingual inscription in the cockpit states that it was a gift of the Union of Socialist and Rural Youth on the XIII Congress and 40th anniversary of the VLKSM ("Komsomol" union). The glider was piloted by "Yuzef Dankovskii (? Jusef Dankowsky in Polish) who left Warszawa on April 13 at 11.00 hrs., towed by a Yak-12. The intermediate landings were made at Bialystok, Vil'nyus and Vitebsk. The total flying time was nine hours.

This gift was handed over at Vnukovo aerodrome.

Sovetskaya Aviatsiya does not, however, mention the designation "Bocian" nor the other seven gliders.

Southampton. DENYS J. VOADEN.

Roundabout

Choppers and Skimmers. From Jamaica, Colin "Copter" Cooper writes of the thriving Caribbean helicopter trade (sales 1.25 a month during the last year) and his company's extension into "frozen-wing" aircraft agencies, including one for Colonial Aircraft's Skimmer amphibian. He agrees with John Fricker that amphibians are wonderful sport—but expensive. Within two days of delivery, the Skimmer (uninsured, rates sky-high) had struck a water obstruction and had to be beached. Temporary repairs quickly effected but back to the States for proper repairs. In the amphibian business you *must* have a sinking fund.

*

Time for Crime. When, on a certain airline service, a passenger was thought to have been overlong in the toilet and did not respond to calls, the door was forced open and he was discovered to have got through into the freight hold, where he was rather selfishly transferring valuables into his own suitcase. With the ever-increasing airborne duration of airliners, and the crossing of the International Date Line, these villains, when at work, now have ample time—even from Monday unto Saturday.

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Mis-prints we can do without. Reporting the N.A.39's first flight, one paper spoke of "Davy's New Fighter." Crockett or Jones? Davy Jones, with his under-sea locker, has a bearing but the implication is unthinkable. Not that the aeroplane's designer, Barry Laight, will fret about it. Thirteen, he says, is his lucky number, therefore the 39 is thrice lucky.

*

"What is 'anti-gravitic'?"

"Oh, it's something Martin's do because Boeing's do it."

Or if you're a Martin man:

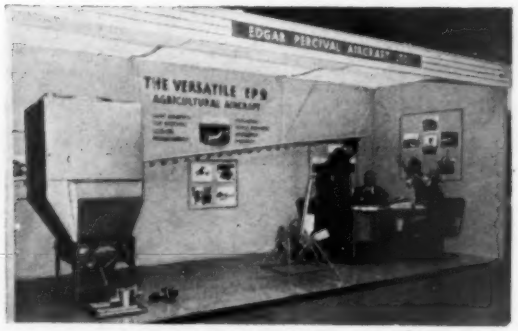
"Oh, it's something Boeing's do because Martin's do it."

*

Stories we'd like to believe. One dark night a loose formation of Hastings was discovered flying through a similar formation of Beverleys going the same way. The Beverleys put on all interior lights so that the port holes would show in addition to the navigation lights. Suddenly a voice on the radio said: "Christmas! I've just flown between two blocks of flats!"

by Lorenz

NOTES AND EVENTS



ENTERPRISE.—The stand of Edgar Percival Aircraft, Ltd., depicting the wide variety of uses for the EP.9, at the Crop Protection and Pest Control Exhibition in the Royal Horticultural Society's New Hall, Westminster.

EQUIPMENT APPROVAL. — The Design Organization of Airmed, Ltd., Harlow, Essex, has recently received A.R.B. approval for the design of oxygen masks and associated equipment, including microphone/telephone headsets and assemblies. This equipment is to be shown for the first time at the next S.B.A.C. Display.

BUYERS' GUIDE. — British Nylon Spinners, Ltd., has issued a new edition of its Buyers' Guide. Published in two separate volumes, copies are available from the company's promotion department at 25 Upper Brook St., London, W.1.

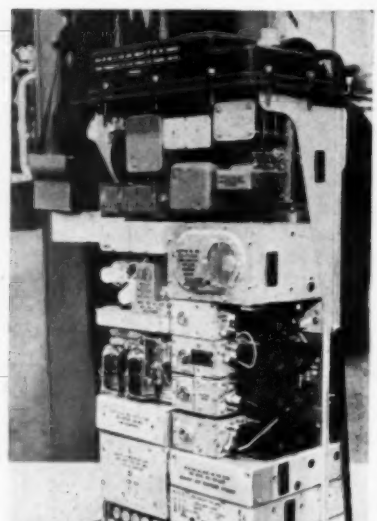
FAST FILMING.—The Fourth International Congress on High-speed Photography, Cinematography, Measuring Techniques and Their Application takes place in Cologne, September 22-27, at the High School of Photography. Details are obtainable from the Deutsche Gesellschaft für Photographie, e.V., Köln am Rhein, Hahnenstrasse 1, Western Germany.

PYE TRANSMITTER.—A new 1-kW. VHF transmitter is now being produced by Pye Telecommunications, Ltd., of Cambridge. A medium-powered communications equipment which has been designed primarily for airport ground-to-air operations, the transmitter covers the 118 to 136 Mc/s frequency range.

TITANIUM WELDING. — William Jessop and Sons, Ltd., of Sheffield, has published a new information sheet (M783) dealing with the welding of titanium alloys. It briefly describes up-to-date techniques for the fusion-, resistance- and flash-welding of Hylite 10, 15, 20 and 45.

DEXION ANGLE.—A new version of the Dexion 140 slotted angle is now available. Manufactured in aluminium alloy as well as steel, it has increased strength and improved rigidity over the existing Type 140, which will no longer be produced.

PUBLICITY AGENTS.—The Dowty Group of companies of Cheltenham have appointed Francis Butters, Ltd., of 9 Hertford Street, London, W.1, as their public relations consultants.



Photographs copyright "The Aeroplane"

RADIO EQUIPMENT.—The AN/ARC-52 1,750-channel UHF transmitter/receiver for military aircraft being manufactured under licence by the Plessey Co., Ltd. Operating in the 225 to 399.9 Mc/s band, the unit, weighing 48 lb., can be modulated for ADF operation with associated direction-finding equipment.

Aviation Calendar

May 24-26.—R.Ae.C. of Belgium *bienvenue aérienne* at **Brussels.**

May 25-June 1.—Second International d'Angers gliding competition organized by l'Aéro Club de l'Ouest, **France.**

May 26.—R.A.F.A. (Eastern Area) Air Display at **Hucknall Aerodrome,** Nottingham.

May 26.—Race Meeting organized by the Tiger Club at **Sandown Airport,** Isle of Wight, for the Basil Monk Trophy.

May 28.—Kronfeld Club talk, "The Cambridge University Gliding Club," by John Pringle, at 74 Eccleston Square, **London,** S.W.1, at 20.00 hrs.

May 29-June 1.—R.Ae.C. International Invitation Air Rally at **Shoreham Aerodrome,** Sussex.

May 31-June 1.—British Women Pilots' Association, Flying Week-end, at **Sandown Airport,** Isle of Wight.

June 1.—*Ralile Bonneterie*, organized by l'Aéro-Club de l'Aube, at **Troyes,** France.

June 1-3.—Pruvost Grand Prix for helicopters, organized by Aéro-Club de France, **France.**

June 4.—Kronfeld Club, talk by David Ince, "Flying the Olympia 419," etc., at 74 Eccleston Square, **London,** S.W.1, at 20.00 hrs.

June 6.—Helicopter Association of Great Britain lecture, "Turbine Helicopters," by D. L. Hollis Williams, B.Sc., F.R.Ae.S. (Westland Aircraft, Ltd.), in the R.Ae.S. Library, 4 Hamilton Place, **London,** W.1, at 18.00 hrs.

June 7.—Air Display at **Swansea Airport.**

June 7.—Helicopter Association of Great Britain Garden Party at Dunsborough Park, **Ripley,** Surrey, at 14.30 hrs.

June 7-8.—Fifth International Rally of Basse-Normandie, at **Flers,** France.

June 14.—Elstree Flying Club "At Home," at **Elstree Aerodrome,** Herts.

June 14.—Plymouth Aero Club Air Display, at **Roborough Aerodrome,** Plymouth.

June 14-15.—P.F.A. Rally at **Rhoose Airport,** Cardiff.

June 15.—Jodel Air Rally, at **Laon,** France.

June 15-29.—World Gliding Championships organized by the Polish Aero Club, at **Leszno,** Poland.

B-58 SIMULATOR.—The U.S.A.F. has ordered a Convair B-58 Hustler flight simulator from Link Aviation, Inc., of Binghamton, N.Y. Valued at more than $1 million, the initial contract is for a single prototype unit. Link has already developed simulators for the Convair F-102 Delta Dagger and F-106 Delta Dart, the Grumman F11F-1 Tiger and the Chance Vought F8U-1 Crusader.

Company Notices

NEW COMPANIES

Midland Aviation (Elmdon), Ltd. (603,964).—Private co. Reg. May 2. Cap. £1,000 in £1 shs. Objects: To carry on the business of agents for the handling of goods and passenger traffic by air, etc. Directors: Laurence B. Bloxham, "Yenton," 20 Mirfield Rd., Solihull, Warwicks; Arthur S. Godfrey, 29 Knoll Drive, Coventry. Reg. off.: Building 25, Elmdon Airport, Birmingham, 26.

Resistor Metals, Ltd. (603,740).—Private co. Reg. April 30. Cap. £5,000 in £1 shs. Objects: To carry on the business of manufacturers of and dealers in metallic and ceramic materials, including their research and development, and their uses in relation to aircraft and other airborne objects and missiles, radomes and other structures, etc. Subscribers (each with one sh.): John G. Stitt, 29 Roland Gardens, London, S.W.7, solicitor; Alfred C. Iverson, 10 Winchester Rd., Tonbridge, solicitor's clerk. First directors: Henry Kremer and Michael Bingham. Solrs.: Blyth Dutton and Co., 112 Gresham House, Old Broad St., London, E.C.2.

Shortcut Aviation, Ltd. (603,949).—Private co. Reg. May 2. Cap. £10,000 in 5,000 "A" shs. of 1s., 5,000 "B" shs. of 1s., and 190,000 "C" shs. of 1s. Objects: To construct, equip, maintain works, purchase and let or hire aeroplanes for the carriage of passengers or freight, etc. Directors: Maurice Cutner, 46 Hyde Park Garden Mews, London, W.2; Lewis Cutner and John Cutner, both of 110 Dorset House, London, W.1; Robert A. Short, "Sunnyside," Tilburstow Hill Rd., South Godstone. The first two are directors of Automatic Services (London), Ltd., etc. Sec.: L. Cutner. Solrs.: A. Oldschool and Co., 24 Harley St., London, W.1. Reg. off.: 232-238 Bishopsgate, London, E.C.2.

New Patents

APPLICATIONS ACCEPTED

797,376.—M. L. Aviation Co., Ltd.—"Aircraft wings."—Sept. 18, 1956. (Sept. 29, 1955.)

797,379.—Soc. Anon. des Ateliers d'Aviation L. Breguet.—"Undercarriage for aircraft."—Nov. 15, 1955. (Nov. 19, 1954.)

Applications open to public inspection on July 2, 1958; opposition period expires on October 2, 1958.

Birth Notices

Allen.—On May 11, at Nocton Hall, Lincoln, to Susan (*née* Wells), wife of Flg. Off. M. Allen, R.A.F.—a son.

Blackburn.—On May 8, at Nocton Hall Hospital, to Enid (*née* Wilkinson), wife of Flt. Lt. R. Blackburn—a son.

McDonald.—On April 30, at Horsham Hospital, to Olga (*née* Moss), wife of Flt. Lt. W. McDonald—a daughter.

Payne.—On May 5, at King's Lynn General Hospital, to Barbara (*née* Sawyer), wife of Flt. Lt. S. G. E. Payne, R.A.F.—a daughter.

Simpson.—On May 7, at R.A.F. Hospital Wegberg, Germany, to Olive, wife of Sqn. Ldr. E. V. C. Simpson—a daughter.

Snape.—On May 4, in Germany, to Emily (*née* Kirkam), wife of Flt. Lt. D. E. Snape, R.A.F.—a daughter.

Snook.—On May 11, at St. Mary's Hospital, to Pauline (*née* Goodson), wife of Beverley J. Snook—a son.

Tyler.—On May 7, to Diana (*née* Browne), wife of Flt. Lt. G. Tyler, R.A.F. Henlow—a daughter.